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THE NORTH AMERICAN SLIME-MOULDS

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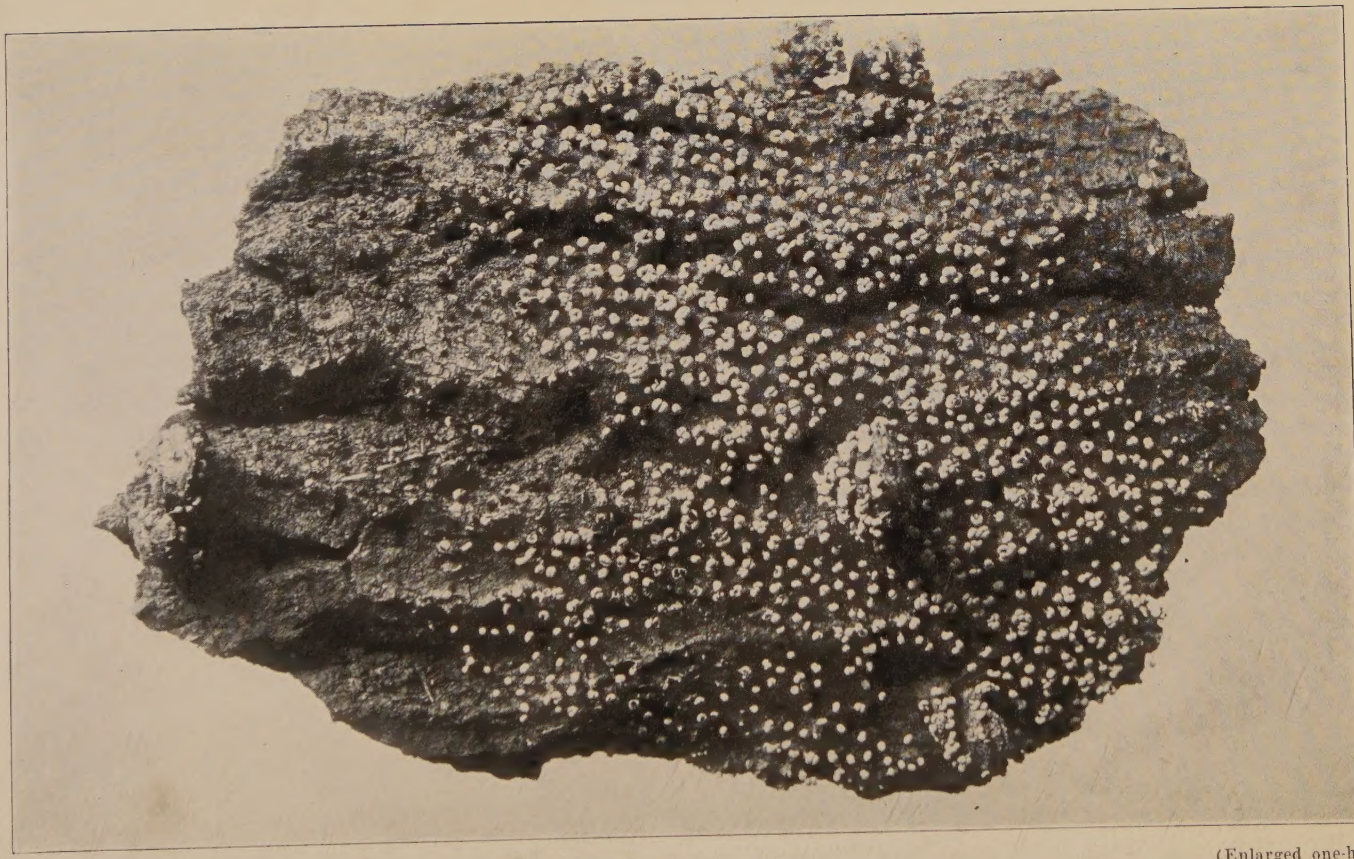

PHYSARUM NOTABILE (Enlarged one-half)

In the field: sporangia in varied magnification, due to inequality in background.

THE NORTH AMERICAN SLIME-MOULDS

A DESCRIPTIVE LIST OF

ALL SPECIES OF MYXOMYCETES
HITHERTO REPORTED FROM THE CONTINENT OF
NORTH AMERICA

WITH NOTES ON SOME EXTRA-LIMITAL SPECIES

BY

THOMAS H. MACBRIDE

STATE UNIVERSITY OF IOWA

NEW AND REVISED EDITION

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·IN · MEMORIAM·

·SAMUELIS · CALVINI ·

· SCIENTIAE · NATURALIS · IN · UNIVERSITATE · IOWENSI ·
· NUPER · PROFESSORIS ·

· PRAECEPTORIS · COMITIS · AMICI ·

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·DISCIPULUS·

"Ihr naht euch wieder schwankende Gestalten,
Die früh sich einst dem trüben Blick gezeigt."

GOETHE.

"Diese Kinder der Natur, welche aus einer ungeformten Gallert, und einem unsichtbaren Saamen entstehen, sind im stande, in dem sie sich nach und nach entwickeln und ihre scheinbar nachlässige Bildung genau beobachten (lassen), eben so sehr als die schönste Pflanze, einem empfindenden Herzen die tiefe Achtung und das paradiesische Vernügen zu verschaffen, welches einzig die Betrachtung der Heere der Natur und ihre gleichbleibende Erhaltung durch eine ewige Kraft hervorbringen kann."

A. J. G. C. BATSCH 1783.

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PREFACE TO THE FIRST EDITION[1]

The present work has grown out of a monograph entitled *Myxomycetes of Eastern Iowa,* published by the present author about eight years ago. The original work was intended chiefly for the use of the author's own pupils; but interest in the subject proved much wider than had been supposed, and a rather large edition of that little work was speedily exhausted. At that time literature on the subject in question — literature accessible to English readers — was scant indeed. Cooke's translation of Rostafinski, in so far as concerned the species of Great Britain, was practically all there was to be consulted in English.

In 1892 appeared in London Massee's *Monograph of the Myxogastres,* and two years later in the same world's centre the trustees of the British Museum brought out Lister's *Mycetozoa.* Although these two English works both claim revision of the entire group under discussion, the latter paying special attention to American forms, nevertheless there still seems place for a less pretentious volume which for American students shall present succinct descriptions of North American species only. The material basis of the present work consists of collections now in the herbarium of the State University of Iowa. In accumulating the material the author has had the generous assistance of botanists in all parts of the country, from Alaska to Panama, and the geographical distribution is in most cases authenticated by specimens from the localities named. The descriptions, in case of species represented in Europe, are based upon those of European authors; for forms first described in this country, the original descriptions have been consulted. A bibliography follows this preface.

In reference to the omnipresent vexed question of nomenclature, a word is perhaps necessary. De Candolle's rule, "The first authentic specific name published under the genus in which the species now

[1] *The North American Slime Moulds,* 1899.

stands," may be true philosophy, but it is certainly an open question how that rule shall be applied. If an author recognized and defined a given species in times past, and, in accordance with views then held, assigned the species to a particular genus, common honesty, it would seem, would require that his work be recognized. To assume that any later writer who may choose to set to familiar genera limits unknown before shall thereby be empowered to write all species so displaced his own, as if, forsooth, now for the first time in the history of science published or described, is not only absolutely and inexcusably misleading, but actually increases by just so much the amount of *débris* with which the taxonomy of the subject is already cumbered.

In face of a work so painstaking and voluminous as that of Rostafinski, and in view of the almost universal confusion that preceded him, it would seem idle to change for reasons purely technical the nomenclature which the Polish author has established. Especially is this true in the case of organisms so very perishable and fragile as those now in question where comparative revision is apt to result in uncertainty. We had preferred to leave the Rostafinskian, *i. e.* the heretofore current nomenclature, untouched; but since other writers have preferred to do otherwise, we are compelled to recognize the resultant confusion.

Slime-moulds have long attracted the attention of the student of nature. For nearly two hundred years they find place more or less definite in botanical literature. Micheli, 1729, figures a number of them, some so accurately that the identity of the species is hardly to be questioned. Other early writers are Buxbaum and Dillenius. But the great names before Rostafinski are Schrader, Persoon, and Fries. Schrader's judgment was especially clear. In his *Nova Genera,* 1797, he recognizes plainly the difference between slime-moulds and everything else that passed by the name of fungus, and proposed that they should be set off in a family by themselves,[1] but he suggested no definite name. Nees (C. G.) also made the same observation in 1817, and proposed the name *Ærogastres;* but he cites as type of his ærogastres, *Eurotium,* and includes so many

[1] Schrader, *Nova Plantarum Genera,* 1797, pp. vi–vii.

fungi, that it seems unsafe now to approve his nomenclature. Schrader also has left an excellent account of the cribrarias, the basis of all that has since been attempted in that genus.

Persoon, in his *Synopsis,* 1801, attempts a review of all the fungi known up to that time. His notes and synonymy are invaluable, enabling us to understand the references of many of the earlier authors where these had otherwise been indefinite if not unintelligible. He makes a great many changes in nomenclature, and excuses himself on the ground that he follows, in this particular, illustrious examples! Unfortunately, so do we all!

Fries, in his *Systema Mycologicum,* 1829, summed up in most wonderful way the work of all his predecessors and the mycologic science of his time. In reading Fries the modern student hardly knows which most to admire, the author's far-reaching, patient research, the singular acumen of his taxonomic instinct, the graceful exactness of the Latin in which his conclusions are expressed, or the delicate courtesy with which he touches the work even the most primitive, of those his predecessors or contemporaries. Nevertheless in our particular group even the determinations of Fries are not conclusive. He himself often confesses as much. The microscopic technique of that day did not yield the data needful for minute comparison among these most delicate forms.

It remained for DeBary and Rostafinski to introduce a new factor into the description of species, and by spore-measurement and the delineation of microscopic detail to supply an element of definiteness which has no parallel in the work of any earlier student of this group. Under these conditions the revision undertaken by Rostafinski was of a most heroic sort. His work was almost a new beginning; and while in nomenclature he was inclined to follow the Paris Code, yet the inadequacy of the earlier descriptions often made such a course impracticable. The synonymy of Rostafinski is largely that of Fries, and upon this the Polish author attempts to apply the law of priority. In the historical note, *wzmianka historyczna,* accompanying the description of each specific form, he generally states the reason for the nomenclature he adopts, whether selected from the mass of supposed synonymy or introduced by himself *de novo.* Un-

fortunately, Rostafinski is sometimes purely arbitrary in his selections. He sometimes changes a specific or even generic name, otherwise correctly applied, simply because in primary etymological significance the name seems to him inappropriate. In such cases it is proper to restore the earlier name. Nevertheless Rostafinski is still our most trustworthy guide.

Of course, where later investigations have served to obliterate the once-thought patent distinctions between supposed genera or species, it is proper to unite such forms under the older determinable titles and this we have attempted. But wherever in the present work a name has been changed, the name of the earlier author will be found in parenthesis, followed immediately by that of him who made the change, and in general, recent practice, especially as expressed in the rules of the various codes, has determined the puzzling questions of nomenclature.

In justification of the use of *Myxomycetes* as a general title it may be said that in this case prevalent usage is not inconsistent with a rational application of the rules of priority. The Friesian designation *Myxogastres* was applied by its author in 1829 to the endosporous slime-moulds as a section of gasteromycetous fungi. Four years later Link, perceiving more clearly the absolute distinctness of the group, substituted the name *Myxomycetes*. In the same year Wallroth adopted the same designation, but strangely confused the limitations of the group he named. Wallroth seems to have thought *Myxomycetes* a synonym for *Gasteromycetes* Fries. In 1858 DeBary applied the title *Mycetozoa* to a group which included the then lately discovered *Acrasieae* with the true slime-moulds, both endosporous and exosporous. For all except the *Acrasieae* DeBary retained the old appellation, Myxomycetes. Rostafinski adopted DeBary's general name, but changed its application. As it has been shown, since DeBary's time, that the *Acrasieae*[1] have no true plasmodium, and are therefore not properly, or at least not necessarily, associated with the slime-moulds, there appears no necessity for the term *Mycetozoa,* and the question lies between *Myxogastres* and *Myxomycetes.* Of these two names the former, as we have seen, has

[1] Cf. Edgar W. Olive, *Monograph of the Acrasieae;* Boston, 1902.

undoubted priority, but only as applied to the endosporous species. The same thing was true of Link's designation until DeBary redefined it, but having been taken up by DeBary, redefined and correctly applied, Myxomycetes (Link) DeBary must remain the undisputed title for all true slime-moulds, endosporous and exosporous alike.

In arranging the larger divisions of the group the scheme of Rostafinski has been somewhat modified in order to give expression to what the present author deems a more natural sequence of species. The highest expression of myxomycetan fructification is doubtless the isolated sporangium with its capillitium. This is reached by successive differentiations from the simple plasmodium. The æthalium may be esteemed in some instances a case of degeneration, in others of arrested development. In any event in the present arrangement, æthalioid forms are first disposed of, leaving the sporangiate species to follow from plasmodiocarpous as directly as may be.

The artificial keys herewith presented proceed on the same plan and are to be taken, as such keys always are, not as definitive in any case, but simply as an aid to help the student more speedily to reach a probably satisfactory description.

PREFACE TO THE SECOND EDITION

The first edition of this little book having been exhausted long ago, the writer in this second issue takes opportunity to correct sundry errata, typographical and other, and at the same time to incorporate such new information in reference to individual species and to the subject entire as the researches of more recent years may afford.

To Miss Gulielma Lister, of London, the writer expresses his sense of deep obligation for much assistance in settling difficult matters of nomenclature and identification; it will be found as a result that in most instances the same thing in the two volumes, English and American, appears under the same name. There are still dif-

ferences; these result in most cases from different points of view, different estimates or emphasis of characteristics in these ever elusive objects.

To Professor Torrend, formerly of Lisbon, the writer is indebted for a set of European types, and to Professor Bethel, pathologist of Denver, for rich material from the fertile mountains of Colorado and California. To Professor Morton Peck, of Oregon, we are indebted for many notes of the color of plasmodia and for collections of Pacific coast forms. Mr. Bilgram, of Philadelphia, read the manuscript of the genus *Physarum* and has contributed many rare species. To Dr. Sturgis, of Massachusetts, we are indebted for material from both east and west.

The present volume is intended especially for American readers and is accordingly particularly devoted to a discussion of species so far reported on the western continent; nevertheless it has seemed wise to include a brief description of some other forms as well, and reference to many extra-limital species now generally recognized will be found here and there in connection with the more extended treatment of related American forms.

February twenty-eight, 1921.

At the last moment, nearly all plates and drawings of the first edition disappeared! necessitating a quick renewal of drawings and plates. This may in part explain lack of uniformity, and various minor irregularities sure to grieve the intelligent student.

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To these may be added the many contributions on the general subject, as these are found in all sorts of current botanical literature; cited everywhere in this volume as occasion offered.

INTRODUCTORY

THE Myxomycetes, or slime-moulds, include certain very delicate and extremely beautiful fungus-like organisms common in all the moist and wooded regions of the earth. Deriving sustenance, as they for the most part do, in connection with the decomposition of organic matter, they are usually to be found upon or near decaying logs, sticks, leaves, and other masses of vegetable detritus, wherever the quantity of such material is sufficient to insure continuous moisture. In fruit, however, as will appear hereafter, slime-moulds may occur on objects of any and every sort. Their minuteness retires them from ordinary ken; but such is the extreme beauty of their microscopic structure, such the exceeding interest of their life-history, that for many years enthusiastic students have found the group one of peculiar fascination, in some respects, at least, the most interesting and remarkable that falls beneath our lens.

The slime-mould presents in the course of its life-history two very distinct phases: the *vegetative,* or growing, assimilating phase, and the *reproductive.* The former is in many cases inconspicuous and therefore unobserved; the latter generally receives more or less attention at the hands of the collector of fungi. The vegetative phase differs from the corresponding phase of all other plants in that it exhibits extreme simplicity of structure, if structure that may be called which consists of a simple mass of protoplasm destitute of cell-walls, protean in form and amœboid in its movements. This phase of the slime-mould is described as plasmodial and it is proper to designate the vegetative phase in any species, as the *plasmodium* of the species. It was formerly taught that the plasmodium is unicellular, but more recent investigation has shown that the plasmodial protoplasm is not only multinuclear but karyokinetic; its cells divide and redivide, as do the *reproductive* cells of plants and animals generally. Nevertheless, in its plasmodial phase, the slime-mould is hardly to be distinguished from any other protoplasmic mass, may be

compared to a giant amœba, and justifies in so far the views of those systematists who would remove the slime-moulds from the domain of the botanist altogether, and call them animals. The plasmodium is often quite large. It may frequently be found covering with manifold ramifications and net-like sheets the surface of some convenient substratum for the space of several square feet.

The substance of the plasmodium has about the consistency of the white of an egg; is slippery to the touch, tasteless, and odorless. Plasmodia vary in color in different species and at different times in the same species. The prevailing color is yellow, but may be brown, orange, red, ruby-red, violet, in fact any tint, even green. Young plasmodia in certain species are colorless (as in *Diderma floriforme*), while many have a peculiar écru-white or creamy tint difficult to define. Not only does the color change, sometimes more than once in the course of the life history of the same species, but it may be the same for several forms, which in fruit are singularly diverse indeed, so that the mere color of the plasmodium brings small assistance to the systematist. In fact, the color depends no doubt upon the presence in the plasmodium of various matters, more or less foreign, unassimilated, possibly some of them excretory, differing from day to day.

In its plasmodial state, as has been said, the slime-mould affects damp or moist situations, and during warm weather in such places spreads over all moist surfaces, creeps through the interstices of the rotting bark, spreads between the cells, between the growth-layers of the wood, runs in corded vein-like nets between the wood and bark, and finds in all these cases nutrition in the products of organic decomposition. Such a plasmodium may be divided, and so long as suitable surroundings are maintained, each part will manifest all the properties of the whole. Parts of the same plasmodium will even coalesce again. If a piece of plasmodium-bearing wood be brought indoors, be protected from desiccation by aid of a moist dark chamber, not too warm (70° F.), the organism seems to suffer little if any injury, but will continue for days or weeks to manifest all the phenomena of living matter. Thus, under such circumstances, the plasmodium will constantly change shape and position, can be in-

duced to spread over a plate of moist glass, and so be transferred to the stage of a microscope, there to exhibit in the richest and most interesting and abundant fashion the streaming protoplasmic currents. As just indicated, the plasmodia follow moisture, creep from one moist substance to another, especially follow nutritive substrata. They seem also to secure in some way exclusive possession. I have never seen them interfered with by hyphæ or enemies of any sort, nor do they seem to interfere with one another. Plasmodia of two common species, *Hemitrichia clavata* and *H. vesparium* are often side by side on the same substratum, but do not mix, and their perfected fruits presently stand erect side by side, each with its own characteristics, entirely unaffected by the presence of the other. On the other hand, it is probable that some of the forms which, judged by their different fructifications, and by this alone, are to us distinct, may be more closely related than we suspect, and puzzling phases which show the distinctive marks supposed to characterize different species are no doubt sometimes to be explained on the theory of plasmodial crossing; they are hybrids.

Under certain conditions, low temperature, lack of moisture, the plasmodium may pass into a resting phase, when it masses itself in heaps and may become quite dry in lumps of considerable size, and so await the return of favorable conditions when former activity is quickly resumed. Sometimes the larger plasmodia pass into the resting phase by undergoing a very peculiar change of structure. In ordinary circumstances the abundant free nuclei demonstrable in the plasmodium afford the only evidence of cellular organization. In passing now into the condition of rest, the whole protoplasmic mass separates simultaneously into numerous definite polyhedral or parenchymatous cells, each with a well-developed *cellulose wall*.[1] When the conditions essential to activity are restored, the walls disappear, the cellulose is resorbed, and the plasmodium resumes its usual habit and structure.

The plasmodial phase of the slime-mould, like the hyphal phase of the fungus, may continue a long time; for months, possibly for years. The reason for making the latter statement will presently appear.

[1] DeBary, *Morphology and Biology of the Fungi*, p. 428.

But however long or short the plasmodial phase continue, the time of fruit, the reproductive phase, at length arrives. When this time comes, induced partly by a certain maturity in the organism itself, partly no doubt by the trend of external conditions, the plasmodium no longer as before evades the light, but pushes to the surface, and appears usually in some elevated or exposed position, the upper side of the log, the top of the stump, the upper surface of its habitat, whatever that may be; or even leaves its nutrient base entirely and finds lodging on some neighboring object. In such emergency the stems and leaves of flowering plants are often made to serve, and even fruits and flowers afford convenient resting places. The object now to be attained is not the formation of fruit alone, but likewise its speedy desiccation and the prompt dispersal of the perfected spores. Nothing can be more interesting than to watch the slime-mould as its plasmodium accomplishes this its last migration. If hitherto its habitat has been the soft interior of a rotten log, it now begins to ooze out in all directions, to well up through the crevices of the bark as if pushed by some energy acting in the rear, to stream down upon the ground, to flow in a hundred tiny streams over all the region round about, to climb all stems, ascend all branches, to the height of many inches, all to pass suddenly as if by magic charm into one widespread, dusty field of flying spores. Or, to be more exact, whatever the position ultimately assumed, the plasmodium soon becomes quiescent, takes on definite and ultimate shape, which varies greatly, almost for each species. Thus it may simply form a flat, cake-like mass, *aethalium,* internally divided into an indefinite number of ill-defined spore cases, sporangia; or the plasmodium may take the form of a simple net, *plasmodiocarp,* whose cords stand out like swollen veins, whose meshes vary both in form and size; or more commonly the whole protoplasmic mass breaks up into little spheroidal heaps which may be sessile directly on the substratum, or may be lifted on tiny stems, stipitate, which may rest in turn upon a common sheet-like film, or more or less continuous net, spreading beneath them all, the *hypothallus.* In any case, each differentiated portion of the plasmodium, portion poorly or well defined, elongate, net-like, spheroidal, elliptical, or of whatever shape, becomes at length a

sporangium, spore-case, receptacle for the development and temporary preservation of the spores.[1]

The slime-moulds were formerly classed with the gasteromycetous fungi, puff-balls, and in description of their fruiting phase the terms applicable to the description of a puff-ball are still employed, although it will be understood that the structures described are not in the two cases homologous; analogous only. The sporangium of the slime-mould exhibits usually a distinct *peridium,* or outer limiting wall, which is at first continuous, enclosing the spores and their attendant machinery, but at length ruptures, irregularly as a rule, and so suffers the contents to escape. The peridium may be double, varies in texture, color, persistence, and so forth, as will be more fully set forth in the several specific descriptions. The peridium blends with the hypothallus below when such structure is recognizable, either directly, when the sporangium is sessile, or by the intervention of a *stipe.* The stipe may be hollow, may contain coloring matter of some sort, or may even contain peculiar spore-like cells or spores; is often furrowed, and in some cases shows a disposition to unite or blend with the stalks of neighboring sporangia. In many cases the stipe is continued upward, more or less definitely into the cavity of the sporangium, and there forms the *columella,* sometimes simple and rounded, like the analogous structure in the *Mucores,* sometimes as in *Comatricha,* branching again and again in wonderful richness and complexity.

Each sporangium is at maturity filled with numerous unicellular spores. These are usually spherical, sometimes flattened at various points by mutual contact; they are of various colors, more commonly yellow or violet brown, are sometimes smooth (?), but generally roughened either by the presence of minute warts, or spines, or by the occurence of more or less strongly elevated bands dividing reticulately the entire surface. The spores are in all cases small 3–20μ, and reveal their surface characters only under the most excellent lenses.

Associated with the spores in the sporangium occurs the *capillitium.* This consists of most delicate thread- or hair-like elements, offering

[1] See, however, *Ceratiomyxa,* p. 18, following.

great variety both in form and structure. The threads composing the capillitium are not to be regarded, even when free, as cells, nor even of cellular origin; probably, as would appear from the researches of Strasburger and Harper, all forms of capillitial threads arise in connection with vacuoles in the protoplasmic mass. "Whether the thread is hollow or solid, simple or branched, free or connected with the peridium or a columella, — these are entirely secondary conditions, depending on the extent and form of the vacuoles."[1] They may occur singly or be combined into a net, they may be terete or flat, attached to the peridial wall or free, simple or adorned with bands or spires and knobs in every variety, uniform or profusely knotted and thickened at intervals, and burdened with calcic particles. In many cases, the capillitium contributes materially to the dispersal of the spores; in others, it doubtless contributes mechanically to the support of the peridial wall, and renders so far persistent the delicate sporangium. For more exact description the reader is again referred to the specific delineations which follow.

The transition from phase to phase requires, as intimated, no great length of time. *Tilmadoche polycephala* completed the transition from vegetative to fruiting phase in less than twelve hours.

The germination of the spores ensues closely upon their dispersal or maturity and is unique in many respects.[2] The wall of the spore

[1] Harper in *Botanical Gazette,* Vol. XXX., p. 219.

[2] The following germination periods are furnished by Dr. Constantineanu (*Inaugural Dissertation ueber die Entwickelungsbedingungen der Myxomyceten;* Halle, 1907).

Reticularia lycoperdon	30 to 60 min.
Fuligo ovata	30 to 90 min.
Stemonitis splendens	5 to 6 hrs.
Perichaena depressa	5 to 8 hrs.
Amaurochaete atra	6 to 10 hrs.
Arcyria incarnata	8 to 10 hrs.
Lycogala epidendrum	to 60 hrs.
Physarum didermoides	1 to 10 da.
Dictydium cancellatum	1 to 20 da.

These records are for sowings in drop cultures, in distilled water, kept at temperature of 65°–70° F. (18°–20° C.).

Our own experiments have been made both with distilled water and tap-water with the advantage in favor of the latter. *Dictydium cancellatum*

is ruptured and the protoplasmic content escapes as a zoöspore indistinguishable so far from an amœba, or from the zoöspore of our chytridiaceous fungi. This amœboid zoöspore is without cell-wall, changes its outline, and moves slowly by creeping or flowing from point to point. At this stage many of the spores assume each a flagellate cilium, and so acquire power of more rapid locomotion. The zoöspores, whether ciliate or not, thus enjoy independent existence and are capable of continuing such existence for some time, assimilating, growing, and even reproducing themselves by simple fission, over and over again. This takes place, of course, only in the presence of suitable nutrient media.

Nevertheless the spores of many species germinate quickly simply in water, and a drop suspended in the form of the ordinary drop-culture on a cover-glass affords ample opportunity. In the course of time, usually not more than two or three days, the swarm spores cease their activity, lose their cilia, and come to rest, exhibiting at most nothing more than the slow amœboid movement already referred to. In the course of two or three days more, in favorable cases, the little spores begin to assemble and flow together; at first into small aggregations, then larger, until at length all have blended in one creeping protoplasmic mass to form thus once again the plasmodium, or plasmodial phase with which the round began. Small plasmodia may generally be thus obtained artificially from drop-cultures. Such, however, in the experience of the writer, are with difficulty kept alive. Hay infusions, infusions of rotten wood, etc., may sometimes for a time give excellent results.

The spores of *Didymium crustaceum* were sown upon a heap of leaves in autumn. An abundant display of the same species followed in the next June; but, of course, the intervening phases were not observed. The most satisfactory studies are obtained by plasmodia carefully brought in directly from the field. A plasmodium that ap-

germinates in tap-water at temperature 70°–80° F. in 12–15 hours fresh from the field. *Fuligo ovata* spores were all swarming in about one hour at the same temperature. Jahn (*Myxomycetenstudien; Ber. der Deutschen Bot. Ges.* Bd. XXIII., p. 495) finds that the germination in some cases as *Stemonitis* species, is hastened by wetting, then drying, then wetting again.

Pinoy thinks microbes aid in germination (*Bull. Soc. Myc. de France* T. XVIII.).

peared suddenly and passed to fruit on agar in a petri dish offers a valuable suggestion for further research.

With such a life-history as that thus briefly sketched, it is small wonder that the taxonomic place of the slime-moulds is a matter of uncertainty, not to say perplexity. So long as men studied the ripened fruit, the sporangia and the spores, with the marvellous capillitium, there seemed little difficulty; the myxomycetes were fungi, related to the puff-balls, and in fact to be classed in the same natural order. The synonymy of some of the more noticeable species affords a very interesting epitome of the history of scientific thought in this particular field of investigation. Thus the first described slime-mould identifiable by its description is *Lycogala epidendrum* (Buxbaum) Fries, the most puff-ball looking of the whole series. Ray, in 1690, called this *Fungus coccineus.* In 1718, Ruppinus described the same thing as *Lycoperdon sanguineum;* Dillenius at about the same time, as *Bovista miniata;* and it was not until 1729, that Micheli so far appreciated the structure of the little puff-ball as to give it a definite, independent, generic place and title, *Lycogala globosum* . . . . , etc.[1]

But Micheli's light was too strong for his generation. As Fries, one hundred years later quaintly says, . . . "immortalis Micheli tam claram lucem accendit ut succesores proximi eam ne ferre quidem potuerint." Notwithstanding Micheli's clear distinctions, he was entirely disregarded, and our little Lycogala was dubbed *Lycoperdon* and *Mucor* down to the end of the century; and so it was not till 1790 that Persoon comes around to the standpoint of Micheli and writes *Lycogala miniata.* Fries himself, reviewing the labors of his predecessors all, grouped the slime-moulds as a sub-order of the gasteromycetes and gave expression to his view of their nature and position when he named the sub-order *Myxogastres.* In 1833, Link, having more prominently in mind the minuteness of most of the species collocated by Fries, and perceiving perhaps more clearly even than the great mycologist the entire independence of the group, suggested as a substitute for the sub-order *Myxogastres,* the order *Myxomycetes, slime-moulds.* Link's decision passed unchallenged for

[1] The plasmodium in this case chances to be red, scarlet, etc.

nearly thirty years. The slime-moulds were set apart by themselves; they were fungi without question and, of course, plants.

If the hypha is the morphological test of a fungus, then it is plain that the slime-moulds are not fungi. No myxomycete has hyphæ, nor indeed anything at all of the kind. Nevertheless, there are certain parasitic fungi, *Chytridiaceae* for example, whose relationships plainly entitle them to a place among the hyphate forms that have no hyphæ whatever in the entire round of their life-history. These are, however, exceptional cases and really do not bear very closely on the question at issue.

Physiologically, the fungi are incapable of independent existence, being destitute of chlorophyl. In this respect the slime-moulds are like the fungi; they are nearly all saprophytes and absolutely destitute of chlorophyl. Unfortunately this physiological character is identically that one which the fungi share with the whole animal world, so that the startling inquiry instantly rises, are the slime-moulds plants at all? Are they not animals? Do not their amœboid spores and plasmodia ally them at once to the amœba and his congeners, to all the monad, rhizopodal world? This is the position suggested by DeBary in 1858, and adopted since by many distinguished authorities, among whom may be mentioned Saville Kent, of England, and Dr. William Zopf, of Germany, in *Die Pilzthiere,* 1885. Rostafinski was a pupil of DeBary's. However, his volume on the slime-moulds was written after leaving the laboratory; and no doubt with the suggestion of his master still before his mind, he adopts the title Mycetozoa, as indicating a closer relationship with the animal world, but our leading authority really has little to say in regard to the matter.[1]

Dr. Schroeter, a recent writer on the subject, after showing the probable connection between the phycochromaceous Algae and the simplest colorless forms, namely, the *Schizomycetes,* goes on to remark: "At the same point where the Schizomycetous series take rise, there begin certain other lines of development among the most diminutive protoplasmic masses. . . . Through the amoebæ one

[1] "Die Myxomyceten sind ebenso den Pilzen wie den echten Thieren verwandt."— Rostafinski; closing sentence of the *Versuch,* thesis for his doctorate at the University of Strasburg, 1873.

of these lines gives rise on the one hand to rhizopods and sponges in the animal kingdom, on the other to the *Myxomycetes* among the fungi." This ranges the Myxomycetes, in origin at least, near the *Schizomycetes.*

The brilliant studies of Dr. Thaxter, resulting in the discovery and recognition of a new group, a new order of the schizomycetes, strikingly confirm the judgment of Schroeter.[1] Here we have forms that strangely unite characteristics of both the groups in question. If on the one hand the *Myxobacteria* are certainly schizomycetes, on the other they just as certainly offer in their developmental history "phenomena closely resembling those presented by plasmodia or pseudo-plasmodia . . " Now the schizophytes certainly pass by gradations easy to the filamentous algæ, and so to relationship with the plants, and the discovery of the *Myxobacteriacae,* brings the myxomycetes very near the vegetable kingdom if not within it.

All authorities agree that the myxomycetes have no connection in the direction of upward development, "keinen Anschluss nach oben," if then their only relationship with other organisms is to be found at the bottom (centre) of the series only, it is purely a matter of indifference whether we say plant or animal, for at the only point where there is connection there is no distinction.

But why call them either animals or plants? Was Nature then so poor that forsooth only two lines of differentiation were at the beginning open for her effort? May we not rather believe that life's tree may have risen at first in hundreds of tentative trunks of which two have become in the progress of the ages so far dominant as to entirely obscure less progressive types? The Myxomycetes are independent; all that we may attempt is to assert their near kinship with one or other of life's great branches.

The cellulose of the slime-mould looks toward the world of plants. The aerial fructification and stipitate habit of the higher forms tends in the same direction. The disposition to attach themselves to some fixed base is a curious characteristic of plants, more pronounced as we ascend the scale; but by no means lacking in many of the simplest, diatoms, filamentous algae, etc., and it is quite as reasonable to call a vorticella, or a stentor, by virtue of his stipitate form and habit, a

[1] *Botanical Gazette,* XVII., pp. 389, etc.; 1892.

plant as to call a slime-mould an animal because in one stage of its history it resembles an amœba. The total life of an organism in any case must be taken into account.[1] At the outset plants and animals are alike; there is no doubt about it; they differ in the course of their life-histories. The plasmodium is the vegetative phase of the slime-mould. It needs no cell-walls of cellulose, no more than do the dividing cells of a lily-endosperm; both are nourished by organic food and resort to walls only as conditions change. The possession of walls is an indication of some maturity. In the slime-mould the assumption of walls is indeed delayed. Walls at length appear and when they do come they are like those of the lily; they are cellulose. The myxomycetes may be regarded as a section of the organic world in which the forces of heredity are at a maximum whatever those forces may be. Slime-moulds have in smallest degree responded to the stimulus of enviroment. They have, it is true, escaped the sea, the fresh waters in part, and become adapted to habitation on dry land, but nothing more. It is instructive to reflect that even in her most highly differentiated forms the channel which Nature elects for the transmissal of all that heredity may bestow, is naught else than a minute mass of naked protoplasm. Nature reverts, we say, to her most ancient and simple phases, and heredity is still consonant with apparent simplicity; apparent we say, for as becomes increasingly evident, nothinging that lives is simple!

The fact is the Myxomycetes constitute an exceedingly well-defined group, and the question of relationship in any direction need not much perplex the student. Least of all is the question to be settled by anybody's dictum, which is apt to be positive inversely in proportion to the speaker's acquaintance with the subject. No one test can be applied as a universal touchstone to separate plants from animals.

[1] Researches of Olive, *Trans. Wis. Acad. Sci., Arts and Let.*, XV., Pt. 2, p. 771, and of Jahn, *Ber. d. Deutsch Bot. Ges.* XXVI., p. 342, and XXIX., p. 231, demonstrate synapsis, and accordingly some form of alternation among the slime-moulds. From the protracted and painstaking investigation of the German author it appears that in *Didymium* at least, and probably *Badhamia* synapsis immediately precedes spore-formation as in *Ceratiomyxa;* that the amœboid issue of the spores are haploid; the nuclei of the plasmodium, diploid; that the ordinary vegetative plasmodium is accordingly sporophytic. That is, the sporophytic phase is dominant, as in higher plants.

Such is simply *petitio principii.* Nor is there any advantage at present apparent in attempts to associate slime-moulds with other presumably related groups. Saville Kent's effort to join them with the sponges was not happy, and Dr. Zopf's association of the slime-moulds and monads appears forced, at best; for when it comes to the consideration of the former, their systematic and even morphological treatment, he is compelled to deal with them by themselves under headings such as "Eumycetozoen," "Höhere Pilzthiere," etc. One rather commends the discreetness of DeBary, whose painstaking investigations first called attention to the uncertain position of the group. After reviewing the results of all his labors DeBary does not quite relegate the slime-moulds to the zoölogist for further consideration, but simply says:[1] "From naked amœba, with which the Mycetozoa (=Myxomycetes) are connected in ascending line, the zoölogists with reason derive the copiously and highly developed section of the shell-forming Rhizopoda . . . And since there are sufficient grounds for placing the rhizopods outside the vegetable and in the animal kingdom, and this is undoubtedly the true position for the amœbæ, which are their earlier and simpler forms, the Mycetozoa, which *may* be directly derived from the same stem, are at least brought very near to the domain of zoölogy."

Notwithstanding all the controversy in regard to the matter, the study of the slime-moulds still rests chiefly with the botanists. A simple phylogenetic scheme for thallophytes is offered in the Strasburger text as follows:—

THALLOPHYTA

1. SCHIZOPHYTA
   - BACTERIA
   - CYANOPHYCEÆ
2. FLAGELLATA
   - *a*
     - MYXOMYCETES
     - PERIDINEÆ
     - CONJUGATÆ
     - HETEROCONTÆ
   - *b*
     - CHLOROPHYCEÆ
     - CHARACEÆ
3. RHODOPHYCEÆ
4. FUNGI

[1] Cf., 1884, *Ver. Morph. u. Biol. der Pilz. Mycet. u. Bact.*, p. 478. Italics, in quotations, ours.

About 500 species of slime-moulds have been described. Saccardo enumerates 443, inclusive of those denominated doubtful or less perfectly known. These 443 species are distributed among 47 genera, of which 15 are represented by but a single species each,— monotypic. In the United States there have been recognized about 300 species. Of those here described, some are almost world-wide in their distribution, others are limited to comparatively narrow boundaries. The greater number occur in the temperate regions of the earth, although many are reported from the tropics, and some even from the arctic zone. Schroeter found *Physarum cinereum* at North Cape. Our Iowa forms are much more numerous in the eastern, that is, the wooded regions of the state. *Physarum cinereum* has however been taken on the untouched prairie, and on the western deserts, as also *Physarum contextum* on the decaying stem of *Calamagrostis,* far from forest

As to the economic importance of our myxomycetes, there is no long chapter to write. Fries says: "Usu in vita communi parum admodum sese commendant, sed in œconomia naturæ certe non spernendi. Multa insectorum genera ex eorum sporidiis unica capiunt nutrimenta." However this may be, there is one species which has come to light since Fries's day which is the source of no inconsiderable mischief to the agriculturist. *Plasmodiophora brassicae* occasions the disease known as "club-root" in cabbage, and has been often made the subject of discussion in our agricultural and botanical journals.[1] Aside from the injurious tendencies, possible or real, of the forms mentioned, I know not that all other slime-moulds of all the world, taken all together, affect in any slightest measure the hap or fortune of man or nation. And yet, if in the economic relations of things, man's intellectual life is to be considered, then surely come the uncertain myxos, with their fascinating problems proffered still in forms of unapproachable delicacy and beauty, not without inspiration.

[1] See *Journal of Mycology,* Washington, D. C., Vol. VII., No. 2; also *Bulletin No. 66, Agric. Station of Vermont.* See also *Bull. 33 Arizona Agric. Ex. Station:* An Inquiry into the Cause and Nature of Crown-Gall. J. W. Tuomey. Also *Bull. Torrey Bot. Club,* Vol. 21, p. 26, where it appears that club-root may attack crucifers generally.

Professor B. M. Duggar in *Fungous Diseases of Plants,* pp. 97–102, gives to club-root an illustrated chapter.

Collection and Care of Slime-Mould Material

On this subject a word may here be appropriate. As just now intimated, specimens may be taken at the appropriate season in almost any or every locality. Beginning with the latter part of May or first of June, in the Northern states, plasmodia are to be found everywhere on piles of organic refuse: in the woods, especially about fallen and rotting logs, undisturbed piles of leaves, beds of moss, stumps, by the seeping edge of melting snow on mountain sides, by sedgy drain or swamp, nor less in the open field where piles of straw or herbaceous matter of any sort sinks in undisturbed decay. Within fifty years tree-planting in all the prairie states has greatly extended the range of many more definitely woodland species, so that species of *Stemonitis,* for instance, are common in the groves on farms far into Nebraska and Dakota. In any locality the plasmodia pass rapidly to fruit, but not infrequently a plasmodium in June will be succeeded in the same place by others of the same species, on and on, until the cold of approaching winter checks all vital phenomena. The process of fruiting should be watched as far as possible, and for herbarium material, allowed to pass to perfection in the field.

Specimens collected should be placed immediately in boxes in such a way as to suffer no injury in transport; beautiful material is often ruined by lack of care on the part of the collector. Once at the herbarium, specimens may be mounted by gluing the supporting material to the bottom of a small box. Boxes of uniform size and depth may be secured for the purpose. Some collectors prefer to fasten the specimen to a piece of stiff paper, of a size to be pressed into the box snugly, but which may be removed at pleasure. Every pains must in any case be taken to exclude insects. Against such depredators occasional baking of the boxes on the steam radiator in winter is found to be an efficient remedy.

For simple microscopic examination it will be found convenient to first wet the material with alcohol on the slide, then with a weak solution of potassic hydrate, to cause the spores and other structures to assume proper plumpness. A little glycerine may be added or run under the cover if it is desired to preserve the material for further or prolonged study. For permanent mounting nothing in most cases is

better than glycerine jelly. As a preparation, the material should lie for some time in Häntsch's fluid,[1] opportunity being given for evaporation of the alcohol and water. When the material shows the proper clearness and fulness, it may be mounted in jelly in the usual way. Kaiser's formula gives beautiful results. After mounting, the preparation should be sealed with some good cement, as Hollis's glue.

[1] Häntsch's Fluid:—

Alcohol 90%	three parts
Water	two parts
Glycerine	one part

THE NORTH AMERICAN SLIME-MOULDS

THE MYXOMYCETES (*Link*) *DeBary*

Chlorophyl-less organisms whose vegetative phase consists of a naked mass of multinuclear protoplasm, the *plasmodium;* reproduced by spores which are either free or more commonly enclosed in sporangia, and which on germinating produce ciliated or amœboid zoöspores, whose coalescence gives rise to the plasmodium.

The Myxomycetes are,—

A. *Parasites,* in the cells of living plants . . . PHYTOMYXINÆ
B. *Saprophytes,* developed in connection with decaying vegetable matter:
  a. With free spores . . . . . EXOSPOREÆ
  b. With spores in receptacles or sporangia . . MYXOGASTRES

Sub-Class PHYTOMYXINÆ *Schroeter*

1889. *Phytomyxinae* Schroeter, *Engl. u. Prantl.,* I., i., pp. 1 and 5.

The parasitic Myxomycetes affecting plants include but few (four or five) species, distributed among four genera. All are parasites in the cells of particular hosts; their vegetative phase is plasmodial and their spores are formed by the simultaneous breaking up of the plasmodium into an indefinite number of independent cells. But a single genus need here concern us,—

Plasmodiophora *Woronin*

1879. *Plasmodiophora* Woronin, *Pringsh. Jahrb.,* XI., p. 548.

Parasitic in the parenchymatous cells of the roots of living plants, causing noticeable enlargement of the affected organ, producing at length galls, knots, and various deformities and distortions. Spores spherical, smooth, colorless, 16 μ.

I. PLASMODIOPHORA BRASSICÆ *Woronin.*

1879. ***Plasmodiophora brassicae*** Woronin, ***op. cit.***

This species, typical of forms so far reported in this country, infests the roots of cabbages,[1] and produces a very serious disease of that vegetable. In England the malady has long been known under the names "clubbing," "fingers and toes," etc. The roots affected swell greatly, and at length resemble sometimes the flexed fingers of the human hand; hence the English name. As the disease progresses, the roots speedily rot away, to the serious injury of the leaf-bearing portion of the plant. In badly affected fields, sometimes one-half of the crop is utterly destroyed. Careful search continued through several years has not availed to bring this species to my personal acquaintance.

For a full account of the parasitism of this species and its distribution in the United States see *Jour. Myc.,* VII., p. 79; also *Bull.* 66, Agric. Sta. of Vermont.

Sub-Class EXOSPOREÆ *Rost.*

1873. ***Exosporeae*** Rostafinski, ***Versuch,*** p. 2.

Spores developed, superficially, outside the fructification, which consists of sporophores, membranous, or slender and branching; spores white, stalked. A single genus, —

Ceratiomyxa *Schroeter*

1889. *Ceratiomyxa* Schroeter, *Engl. u. Prantl,* I., i., p. 16. For further synonymy, see under first species.

Sporangia none; spores superficial, borne on erect papillæ or pillars, or even on the inside of minute depressions or pits; each spore surmounting a delicate pedicel or stalk. The spores on germinating give rise to amœboid zoöspores, which undergo repeated divisions, later become ciliate, and at length again amœboid to blend into genuine plasmodia. At maturity the plasmodium gives rise to numerous minute divisions, each of which may lengthen in a direction perpendicular to the surface and bear a spore at the tip.

[1] For other crucifers, see *Bull. Torr. Bot. Club,* xxi, pp. 76–8.

The homologies between the structures just described and the fructification of the ordinary slime-mould are somewhat obscure, if indeed any really exist. Are these minute reproductive bodies spores? —their behavior on germination is unique; are they sporangia? —the arrested development they exhibit is none the less puzzling. Perhaps the sporiferous pillars represent incipient stipes, the spores the uncombined fragments of what might otherwise have coalesced at the summit of the pillar to form a true sporangium.[1]

Several species have been recognized, all referable probably to one or two, or at most, four forms. That universally recognized alike in the literature of the past and in recent studies is,—

1. Ceratiomyxa fruticulosa (*Muell.*) *Macbr.*

Plate I., Figs. 7 and 7 *a*.

1729. *Puccinia ramosa, bifurcata,* etc. Micheli, p. 213, Tab. 92, Fig. 2.
1775. *Byssus fruticulosa* Müller, in *Fl. Dan.,* t. 718, Fig. 2.
1778. *Tremella hydnoidea* Jacquin, *Misc.,* Vol. I., t. 16.
1783. *Clavaria puccinia* Batsch, *Elench. Fung.,* p. 139, Fig. 19.
1791. *Puccinia byssoides* Gmelin, *Syst. Naturae,* p. 1462.
1791. *Clavaria byssoides* Bulliard, *Champ. de la France,* t. 415, Fig. 2.
1794. *Isaria mucida* Pers., Römer, *N. Mag. Bot.,* I., p. 121.
1801. *Isaria mucida* Pers., *Syn. Meth.,* p. 688.
1805. *Ceratium hydnoides* Alb. & Schw., *Consp. Fung.,* p. 258.
1811. *Ceratiomyxa porioides* (A. & S.) Schroet., *Mycet.,* p. 26, *var.*
1829. *Ceratium hydnoides* Fries, *Syst. Myc.,* III., p. 294.
1872. *Ceratium hydnoides* Wor. & Fam., *Mem. Acad. Imp.,* Petersburg.
1887. *Ceratium hydnoides* DeBary, *Comp. Morph. Fung.,* p. 432.
1889. *Ceratiomyxa mucida* Schroeter, *Engl. u. Prantl Nat. Pflanz.,* I., i., p. 16.
1893. *Ceratiomyxa mucida,* Pers., Macbr., *Bull. Nat. Hist. Iowa,* II., p. 114.
1894. *Ceratiomyxa mucida* Schroet., Lister, *Mycetozoa,* p. 25.

Plasmodium in rotten wood, white or nearly transparent; when fruiting, forming on the substratum mould-like patches composed of the minute sporiferous pillars, generally in clusters of three or more together; spores white, ovoid, or ellipsoidal, smooth, 10–12×6 μ.

Very common, occurring in summer on shaded rotten logs, espe-

[1] See in reference to this whole matter, *Myxomycetenstudien* by E. Jahn, No. 7, *Ceratiomyxa,* 1908. See also Olive, *Trans. Wis. Acad. of Sci. Arts and Letters,* Vol. xv, pl. II, p. 771.

cially after warm showers and in sultry weather. Easily distinguishable from all similar moulds by the absence of mycelium or of anything like a hypha. In Europe the plant seems to be in autumn exceedingly common. Micheli not only described the form but figured it, nearly two hundred years ago. Micheli's figure is good, as is that of Mueller, *Fl. Dan.,* l. c. Mueller referred the species to a Linnean genus *Byssus,* which seems to have included Algæ rather than anything else, if one can determine its limits at all. The same thing is true of *Tremella;* but this name is now otherwise applied, as are all the other generic names down to *Ceratium,* Alb. & Schw. But this had been by Schrank preoccupied, 1793. See the reference above for 1889. As for specific name, there seems no reason to depart from the rule of priority, since Mueller's work is determinative.

Ceratiomyxa arbuscula, Berk. & Br., apparently a form of this, is cited from Toronto by Miss Currie. Massee gives it recognition; Lister as varietal. The sporophores are inclined to be simple, stipitate and dendroid.

C. filiforme of the English authors latest named is a wonderful thing and deserves a paragraph here, if not recognition as a distinct species. It occurs rarely; but once it appears, attracts attention. As in the historic species, the sporifers are white, stand more or less erect, but are every way finer and larger. Each individual sporifer rises like a stiff stem, as of white thread, 2–3 mm. high; at top a tuft of fruiting branchlets, more or less distinct. All taken together, we have a dense mat completely concealing the substratum and spreading out sometimes over an area of surprising extent, several centimetres square.

Common everywhere in summer on decaying sticks and wood of every description, especially in wet places. Alaska to Nicaragua,and probably around the world.

2. Ceratiomyxa porioides (*Alb. & Schw.*) *Schroeter.*

1805. *Ceratium porioides* Alb. & Schw., *Consp. Fung.,* p. 359.
1829. *Ceratium porioides* Fries, *Syst. Myc.,* III., p. 295.
1873. *Ceratium porioides* Fam. & Wor. *Acad. Imp.,* XX., 3, p. 5.
1889. *Ceratiomyxa porioides* Schroet., *Engl. u. Prantl,* I., i., p. 16.

1894. *Ceratiomyxa mucida* Schrœt. var. *porioides* Lister, *Mycetozoa,* p. 26.
1899. *Ceratiomyxa porioides* Alb. & Schw. (Schroet.), Macbr., *N. A. S.,* p. 19.
1911. *Ceratiomyxa porioides* Alb. & Schw., Schroet., *List. Mycet.,* p. 26, *var.*

Entire fructification confluent forming a mucilaginous mass, porose. Pores ample, angulate, at length radiate-dentate. Spores as in the preceding. Plasmodium yellow.

Of these two species Fries remarks: ". . . Duæ sunt distinctissimæ, inter has vero longa formarum intermediarum series." Famintzin and Woronin not only concur, but consider it were more fitting to place the present species in a distinct genus, as *Polyporus* is set off from *Hydnum.* A species based upon the color of the vegetative phase only, unconfirmed by any subsequent differential character in the fruit would seem somewhat hazardous. The color of the plasmodium is incident probably to varied nutrient environment. Pores, however, are usually in evidence.

Iowa, Tennessee, Missouri, etc.; probably common everywhere.

Sub-Class MYXOGASTRES (*Fries*) *Macbr.*

1829. Sub-order *Myxogastres* Fries, *Syst. Myc.,* III., p. 67.
1833. Sub-order *Myxomycetes* Link, *Handb. der Gew.,* 3, p. 405.
1833. Sub-order *Myxomycetes* Wallroth, *Fl. Crypt.,* II., p. 333, in part.
1858. Class *Mycetozoa* DeBary, *Bot. Zeitung,* 1858, pp. 357–365, in part.
1889. Class *Myxogastres* Schroeter, *Engl. u. Prantl,* Nat. Pflanz., I., i., p. 16.
1892. Class *Myxogastres* (Fries) Massee, *Monograph,* p. 28.
1894. Class *Mycetozoa* Lister, *Mycetozoa,* p. 21, in part.

Except as just described, the slime-moulds present abundant, minute, unicellular spores, enclosed in sporangia more or less perfectly defined, and attended by peculiar thread-like structures, free or variously attached and conjoined, the so-called *capillitium.*

So far as known, the spores on germination give rise to zoöspores, at first amœboid, later ciliate, again amœboid, conjugating in pairs, then, in some cases, at least, coalescing and dividing indefinitely to form the plasmodial or vegetative phase.[1]

[1] See Jahn, *Myxomyceten Studien* No. 8, Berlin 1911.

Key to the Orders of the Myxogastres

Spore-mass black or violaceous, rarely ferruginous . . . Series A
Spore-mass never black; usually some shade of brown or yellow, rarely purplish or rosy, etc. . . . . Series B

SERIES A

1. Capillitium present, delicate, thread-like; sporangia calcareous more or less throughout . . . . . I. PHYSARALES
2. Capillitium present, thread-like, arising usually as anastomosing branches from a well-developed columella, which in a single genus contains lime; sporangia otherwise non-calcareous II. STEMONITALES

SERIES B

3. Capillitium none, or very imperfectly developed; spores of some shade of brown, rarely purplish . . . . III. CRIBRARIALES
4. Capillitium the inwardly produced irregular extremities of plates or tubules, which by their interweaving outwardly make up the aethalial wall; spores pale, ashen . . . . IV. LYCOGALALES
5. Capillitium made up of more or less distinctly sculptured threads, parietal or free, simple, branched, or reticulate; spores commonly yellow . . . . . V. TRICHIALES

This sequence is meant to convey the idea that the presence of lime is indicative of differentiation less complete. That the plasmodium should at the outset eliminate, by refusing the unnecessary lime, is indicative of higher rank than that the lime should be carried until the last and then be crystallized out, or excreted by simple desiccation. The circumstance that the excreted lime may sometimes serve a protective purpose in the fruit, does not vitiate the general principle. In Series B the differentiation reaches a climax in the sculptured capillitium of the trichias.

ORDER I

PHYSARALES

Spores violaceous-black. The capillitium usually delicate and thread-like; peridium and capillitium, one or other or both, more or less extensively surcharged with lime. Peridium simple or double. Fructification various.

This order is recognizable by several characteristics, but is especially marked by the peculiar calcareous deposits which affect the capillitium or peridium, now one, now the other, more often both.

As here defined, the order Physarales includes two distinct families; of the one *Physarum,* of the other *Didymium,* is type.

Key to the Families of the Order Physarales

A. Fructification often calcareous throughout; capillitium intricate *Physaraceae*

B. Calcareous deposits, when present, affecting the peridium only, or sometimes the stipe, in the typical genus plainly crystalline; capillitium simple *Didymiaceae*

A. PHYSARACEÆ

Key to the Genera of the Physaraceæ

A. Fructification æthalioid . . . . . 1. *Fuligo*

B. Fructification plasmodiocarpous or of distinct sporangia.

a. Peridium evidently calcareous.

i. Capillitium calcareous throughout . . 2. *Badhamia*

ii. Capillitium largely hyaline.

* Sporangia globose, etc.; dehiscence irregular 3. *Physarum*

** Sporangia vasiform or more or less tubular

† Dehiscence by a lid or more or less circumscissile . . . . . 4. *Craterium*

†† Dehiscence irregular, peridium introverted 5. *Physarella*

b. Peridium apparently limeless, at least outside.

i. Plasmodiocarpous . . . . . 6. *Cienkowskia*

ii. Sporangia distinct . . . . . 7. *Leocarpus*

C. Extra-limital.

a. Sporangia stipitate, saucer-shaped, following No. 3 *Trichamphora*

b. Sporangia elongate allantoid, etc., following No. 1. *Erionema*

1. Fuligo (*Haller*) *Pers.*

1753. *Mucor* Linn., *Sp. Pl.* II., No. 1656 (?).
1768. *Fuligo* Haller, *Hist. Helv.,* Nos. 1233-1235, in part.
1801. *Fuligo* Haller, *Pers. Syn.,* p. 159.
1809. *Æthalium* Link, *Diss.,* I, p. 42.
1829. *Æthalium* Fries, *Sym. Myc.,* III., p. 92.

Sporangia undefined, obscurely woven in and out among each other forming usually a cushion-shaped æthalioid mass. The outer layer sterile, often calcareous, forming a fragile crust, more or less defined. The middle layer sporiferous with calcigerous capillitium. The lowest layer a membranous hypothallus.

The identity of this genus seems to have been recognized first by Haller, *op. cit.,* but by Persoon more closely defined and illustrated. Link simply translated the name into Greek, for reasons less evident now, and in this was followed by Fries. Haller's designation is now probably securely fixed.

The sporigerous median structure of the fructifications, under whatever specific name or names, is entirely confused. Sporangial walls, if ever such there were, are hardly as such recoverable, seemingly *indicated* only, in the changes to which the æthalium submits as in the ripening the sporogenic plasm passes on to spores.

In the present state of our knowledge the forms of this genus present withal a most perplexing problem. Are they simply phases of a single species, or are they in style and in structure sufficiently constant in their admitted variety, to claim specific rank and separate description?

To follow the example of Greville and recognize in all the literature of two hundred years varied descriptions of a single type, — this were perhaps the easier and speedier disposal of the case. Fries thought so to treat the problem but was unable to keep faith with his own decision; for no sooner he states the genus monotypic than he proceeds forthwith to offer four varieties, a. b. c. d., viz. those by Persoon and others duly recognized as species.

Recent students all, however, seem to find convenience in specific division. All seem disposed to honor Dr. Peck's *Fuligo ochracea* whether or not by the name he gave; and of other varieties some seem impressed by the constancy of one, some of another characteristic, thus indicating that to careful observers all over the world there are differences that may be recognized, that have been recognized again and again. If there are two species there are certainly more. Out of the gatherings of many years one may set in order not less than five variations in the fruiting of *Fuligo,* five distinct types

of fructification, to all appearing sufficiently constant for specific recognition.

It will be said, has been said, was said by Fries, that these variations are insignificant, "pendent ex æris constitutione"; but as a matter of fact the several types now in question may be found on the same day, so that evidently something other than the atmospheric environment must determine.

Again it is said that the differences are in external form or color only, the spores in all cases almost if not quite the same. This is true; but specific characters are *surface* characters in fact: a species morphologically is merely the form in which a *kind* or *genus* presents itself. If the presentation be constant, for our convenience we say so, in bestowing a name. Whether in our present treatment the convenience is purely personal, students may decide.

However it all may be, there are in this part of the world many varying presentations of *Fuligo* capable of illustration and description; the same forms, perhaps, which have attracted the notice of the more acute mycologists in the older history of the subject. Some of these forms we here venture to describe, with such annotation as may show something of present knowledge.

Key to the Species of Fuligo

A. Æthalium 1 cm. or less; spores spherical . . 1. *F. muscorum*

B. Æthalium larger, or plasmodiocarpous, even sporangi-form, crust white, smooth, even, spores elliptical . . . . . 2. *F. cinerea*

C. Æthalia larger, 2 cm. or more.

1. Cortex yellow, etc., not white; spores 6–8 μ . 3. *F. septica*
2. Cortex nearly or quite wanting; spores 10–12 4. *F. intermedia*
3. Cortex white, a foamy crust; spores 15–25 5. *F. megaspora*

1. Fuligo muscorum *Alb. & Schw.*

1894. *Fuligo muscorum,* Alb. & Schw. Lister, *Mycetozoa,* p. 67.
1875. *Licea ochracea* Peck, *N. Y. Rep.,* XVIII., p. 55.
1879. *Fuligo ochracea* Peck, *N. Y. Rep.,* XXXI., p. 56.
1894. *Fuligo muscorum,* Alb. & Schw., Lister, *Mycetozoa,* p. 67.
1911. *Fuligo muscorum* Alb. & Schw., Lister, *Mycetozoa, 2nd ed.,* p. 87.

Plasmodium orange-yellow. Æthalium globoid, very small, 1 cm. or less, the cortex very thin, greenish yellow; sporangial walls not evident; capillitium well-developed, the numerous calcareous nodes fusiform or often branching, and connected by rather short, transparent internodes; spores coarsely warted, 10–11 μ.

This form seems to differ from *F. septica* chiefly in its constant diminutive habit of fruiting, in its delicate cortex, and in its spores, brighter, larger, and more coarsely warted. The descriptions and figure by Schweinitz seem referable to nothing else. First reported by Albertini and Schweinitz from Germany; by Schweinitz from the Carolinas; then by Dr. Peck described as a *Licea* from New York. It seems less commonly collected in the United States.

2. Fuligo cinerea (*Schw.*) *Morg.*

Plate X., Figs. 3, 3 *a*, and 3 *b*, and Plate XXIII.

1831. *Enteridium cinereum* Schw., *N. A. F.*, No. 2365.
1875. *Physarum ellipsosporum* Rost., *Mon. App.*, p. 10.
1884. *Æthaliopsis stercoriformis* Zopf., *Pilzthiere*, p. 150.
1894. *Fuligo ellipsospora* Lister, *Mycetozoa*, p. 67.
1896. *Fuligo cinerea* (Schw.) Morg., *Cin. Soc. Nat. Hist.*, p. 105.
1899. *Physarum ellipsosporum* Rost., Macbr. *N. A. S.*, p. 27.
1911. *Fuligo cinerea* Morg., List., *Mycetozoa*, 2nd ed., p. 88.

Plasmodium milk-white, watery. Plasmodiocarp long and widely effused, anon winding, here and there reticulate, always applanate; sometimes in form an æthalium, the peridial cortex membranous, firm, thick, and white. Capillitium well-developed, furnished with lime. Spores thin-walled, ellipsoidal, violaceous, plicate-rugose, 14–16 $\times$ 11–12 μ.

Not common. Found occasionally in shaded situations on piles of rotting straw or in the woods, especially on detritus of the bracken. The spores are many of them ellipsoidal; some are spherical; all are decidedly spinulose, perhaps might appear plicate-rugulose when dry or shrunken. Calcareous nodules very large and irregular, white.

Schweinitz, *loc. cit.*, described this form as *Enteridium cinereum*. Rostafinski referred it to the genus *Physarum*, but was obliged to adopt also a new specific name, as that suggested by Schweinitz was

already in use in the genus *Physarum*. Zopf, *Die Pilzthiere*, p. 149, founds a new genus on what seems to be the same form as here considered. This he publishes as *Æthaliopsis stercoriformis* Z. Massee regards the specimens discovered by Zopf as belonging to the genus *Fuligo*, and Lister regards Rostafinski's type as *Fuligo*, and includes Zopf's material under the Rostafinskian species.

This has been described as properly an American form; Lister cites other far localities.

3. Fuligo septica (*Linn.*) *Gmel.*

1753. *Mucor septicus* Linn., *Sp. Pl.* II., No. 1656 (?).
1763. *Mucor ovatus* Schaeff., *Fung. Bav.*, p. 132, Fig. 192.
1791. *Fuligo septica* (Linn.) Gmel., *Syst. Nat.*, p. 1466.
1826. *Fuligo varians* Sommf., *Fl. Lapl. Sup.*, p. 231.
1809. *Æthalium flavum* Link, *Diss.*, I., p. 42.
1829. *Æthalium septicum* Fr., *Syst. Myc.*, III., p. 93.
1875. *Fuligo varians* Sommf., Rost., *Mon.*, p. 134.
1892. *Fuligo varians* Sommf., Macbr., *Bull. Lab. Nat. Hist. Ia.* II., p. 160.
1894. *Fuligo septica* (Linn.) Lister, *Mycetozoa*, p. 66.
1899. *Fuligo ovata* (Schaeff.) Macbr., *N. A. S.*, p. 23.
1911. *Fuligo septica* Gmel., Lister, *Mycetozoa, 2nd ed.*, p. 86.

This remarkable and universal species presents as stated many forms and phases. Of these five have been selected as representative.

1. Form *a*. Plasmodium yellow; cortex yellow, or orange-brown, strongly calcareous friable; form indefinite . . . . . *F. ovata*
2. Form *b*. Cortex less calcareous porose, yellowish brown, fructification definite, pulvinate . . . . . *F. rufa*
3. Form *c*. Cortex smooth, persistent; fructification small, less than two inches . . . . . *F. laevis*
4. Form *d*. Plasmodium yellow; cortex none; capillitium yellow, fructification thin, sometimes wide-spread . . . . . *F. flava*
5. Form *e*. Plasmodium violaceous, dark; cortex almost none; whole mass reddish or violet . . . . . *F. violacea*

1. Form *a*. *Fuligo ovata* (Schaeff.) Pers.

Plasmodium bright yellow; æthalium pale brown, or yellowish-ochraceous, of variable size and shape, one to many cm. in diameter, and one to two cm. thick, enclosed by a distinct calcareous crust,

which varies in texture, thickness, and color; capillitium well developed but variable in color, form, and extent; spore-mass dull black, sooty; spores spherical, purplish brown, nearly smooth, 7–9 μ.

Under this name may be placed our most common form. Rising with an abundant yellowish creamy plasmodium from masses of decaying vegetation, lumber, sawdust, half buried logs, it creeps about with energy unsurpassed, coming to rest only in some position specially exposed, as the top of a log or stump, the face of a stone or post, or even the high clods of a cultivated field! The fructification is large, yellow, or at most pale ochraceous, the surface when mature extremely friable like dry foam. Bulliard figures this phase well on Plate 424, Fig. 2, and calls it *Reticularia* (*Fuligo*) *hortensis,* from its affecting the soils of gardens. More than thirty fructifications have appeared at one time, varying in size from one to twenty cm. in a field of potatoes, well tilled, and less than an acre in extent! Such is life's perennial exuberance on this time-worn old world of ours!

Schæffer's plate CXII represents probably the same thing. So also Bolton's plate, CXXXIV. Sowerby's Fig. 2 on plate 199, and figures 1 and 2 on Greville's plate 272 possibly also depict this form. Persoon calls this *F. vaporaria* because it frequents hotbeds and the like, and believes this to represent the *"untuosus flavus"* of Linnée, although he thinks Schæffer's specimens do not. The calcareous internal structure is white.

2. Form *b, F. rufa* Pers.

This type of Fuligo is very different from the preceding in form, habit, and color. In form it is much more definite, usually thick, well-rounded and with some solidity. The interior fructification is gray throughout, much less expanded than in *a*; in fact does not resemble *a* at all! The cortex is porose but firm, orange at first, but becoming tawny with age, even in the herbarium. Bulliard figures it well, plate 380, Fig. 1, and Sowerby's Fig. 1 on plate 399 is also good, as are also Greville's figure 3 on plate 272 showing the two colors referred to. Not uncommon in the forest from June till September, but far more rare than *a*: always well-marked, with no other forms associated.

3. Form *c, F. laevis* Pers.

This is a still more specialized type of the group. The fructification is usually small, smooth, about an inch in diameter and sometimes nearly as thick; the cortex rusty brown, enduring, persisting often when all the sporiferous grayish mass has been distributed through chinks, or from below. The figure 2 on plate X. shows this form. This also is a forest species, is autumnal rather, but may be taken sometimes as early as July. The cortex is not at all porose or spongy, in color reddish or brown, fragile indeed, but not to the touch, in the herbarium enduring for years.

4. Form *d, F. flava* Pers.

This is hardly *F. flava* of Persoon; rather of Morgan who uses Persoon's specific designation. Persoon cites Bolton's fig. CXXXIV, which is yellow indeed but is the ordinary presentation of *F. septica.* The form here considered is remarkable for its delicacy; extremely thin, perhaps one layer only of overlying elongate flexuous sporangia(?), covered by the merest shadow of a cortex in the form of yellow dust, soon lost: the capillitial structure yellow throughout; occurring upon fallen logs in moist dark woods; not common.

5. Form *e, F. violacea* Pers.

Plasmodium (Morgan *teste*) dark red, or wine-colored; the æthalium thin, two or three inches wide, covered by a cortex at first dull red and very soft, at length almost wholly vanishing, so that the entire mass takes on a purple-violet tint, upper surface varied with white; capillitium rather open, the more or less inflated, large, irregular nodes joined by long, slender, delicate, transparent filaments; spores dark violet, minutely roughened, spherical, about 7.5 μ.

Ohio, Tennessee. Probably everywhere, but not distinguished from 1.

Professor Morgan, who gave the genus under consideration much attention, regarded *F. violacea* as a form particularly well-defined. What the value of plasmodic color as a specific character in general, and how far such character is in the present case definitive, because constant, are points yet to be determined.

4. Fuligo intermedia *Macbr. n. s.*

Æthalium two to three cm. in greatest diameter, .5–1 cm. thick, covered with a thin, fragile, but not calcareous, greyish or brownish cortex; the spore-mass grey or violaceous-grey, firm, not at all sooty, the sporangia intricate, their walls more or less calcareous; capillitium not conspicuous; spores globose, pale purple, slightly roughened, 10–12 μ.

This form has been repeatedly sent me from Denver, Colorado, by Professor Bethel. I have refrained from publishing it, still anxious to believe that all fuligos on the face of the earth were of one species. In the species next following it must be admitted that the spore-variations are too wide to remain comfortably under shelter of a single specific name. The present species is not *F. septica,* neither is it *F. megaspora;* it is *F. intermedia.*

Colorado; Iowa.

5. Fuligo megaspora *Sturg.*

1913. *Fuligo megaspora* Sturg., *Col. Coll. Pub.,* p. 443.

Æthalium pulvinate one to three inches in diameter, covered with a thick spongy incrustation of lime, white or yellowish toward the base: sporangia convolute, the walls membranous, brittle, charged throughout with round white granules of lime, 1.5–2 μ in diameter: columella none: capillitium of delicate, colorless, anastomosing tubules, bearing toward the center large, white, branching calcareous nodules; spores spherical, or somewhat oval, dark purple-brown, rough-tuberculate, 15–20 μ.

This species differs as pointed out by Professor Sturgis, chiefly in the character of the spores, their unusual size and roughness.[1]

Colorado; Africa! — *Robert Fries.*

[1] In discussing these species the reader may be referred to Professor Harper's study of cytology, *Bot. Gazette,* vol. XXX., p. 217. It is probable that in all these æthalioid forms the effect of disturbance, transfer to laboratory, is likely to be quite pronounced. Giant spores are often seen, doubtless due to arrested cleavage in the procedure described by Dr. Harper: a giant spore is penultimate or antepenultimate in series; should, on this theory, occasionally, at least, show more than one nucleus.

EXTRA-LIMITAL

Erionema *Penzig*

1898. *Erionema* Penzig, *Die Myx. d. Fl. v. Beutenzorg,* p. 36.

Sporangia plasmodiocarpous but distinct, cylindrical; capillitium intricate, elastic; nodules few.

1. Erionema aureum *Penzig*

1898. *Erionema aureum* Penz. *l. c.*

Sporangia elongate, clustered, pendulous, yellow or grayish yellow, generally stipitate on long flaccid stalks, or sessile and interlacing: stipes yellow, blending with the hypothallus; capillitium intricate, expanding at maturity after the manner of *Arcyria* to several times the sporangial length, the nodules small, yellow; spores nearly smooth, violaceous-brown, 5–6 μ.

This unique form is near the fuligos which it resembles, especially when sessile, in its intricate sporangia. The spores also are those of the common *Fuligo septica.* The habit is however entirely different. Mr. Petch describes clusters in Ceylon, hanging free, four to six cm. in length!

2. Badhamia (*Berkeley*) *Rost.*

1852. *Badhamia* Berkeley, *Trans. Linn. Soc.,* XXI., p. 153.
1875. *Badhamia* Rostafinski, *Monograph,* p. 139.

Sporangia simple; peridial wall simple, thin, breaking irregularly; capillitium formed of abundant, richly anastomosing tubules, filled throughout their entire length with calcareous granules; the nodes often feebly represented; stipe poorly developed or wanting entirely; columella, except in forms sometimes assigned to the sub-genus *Scyphium,* poorly developed or none; spores frequently adherent in clusters.

This genus is closely related to *Physarum,* but differs in having the

The whole genus calls for careful and protracted study; and the present so-called species are like something new on the world; as full of vagaries as though but just entered upon their phylogenetic race.

capillitium calcareous throughout. Forms occur and are included here, in which the capillitium, especially in some parts, is physarum-like, physaroid. Nevertheless, the distinctions hold good as a rule, and are at once diagnostic.

In capillitial differentiation the badhamias are definite and beautiful. The net in a typical species, as *B. papaveracea,* is throughout uniformly evenly tubular, the calcareous deposits delicate in the extreme, presenting, as the spores disappear, an elegant trabecular structure as if to support the persisting peridium if not the original content. In other forms the capillitium is physaroid, with swollen nodes, but heavily calcareous but not quite throughout. *Badhamia, Physarum, Tilmadoche, Craterium* present a consistent group, of which *Physarum* is the generalized expression.

Berkeley's idea of the genus was expressed as follows: "Peridium naked or furfuraceous. Spores in groups, enclosed, at first, in a hyaline sack." Rostafinski, while accepting Berkeley's generic name, redefined it, emphasized the calcareous capillitium, and made reference to the spore-adherence only to assert that Berkeley's description was, in this particular, based on mistaken observation. In some species, the spores do, in fact, show a tendency to cling together, a characteristic which Badham was perhaps first to notice; but that this is occasioned by their being surrounded by a sac or common pellicle has not been proved nor even suggested, by any subsequent investigator. Berkeley's genus was therefore founded upon a slight mistake; but we may conserve his rights in the premises if we write *Badhamia* (Berk.) Rost., and so keep history straight.

Key to the Species of Badhamia

A. Spores ovoid or ellipsoidal
- *a.* Spores free . . . . . 1. *B. ovispora*
- *b.* Spores adherent . . . . . 2. *B. versicolor*

B. Spores spherical
- *a.* Sporangia yellow
  - i. Spores free . . . . . 3. *B. decipiens*
  - ii. Spores adhering . . . . . 4. *B. nitens*
- *b.* Sporangia grey, spores free
  - i. Always sessile . . . . . 5. *B. panicea*

ii. Stalked, at least some of them
* Stipe when present black
† Globose, small .5 mm. . . 6. *B. affinis*
†† Larger, spores strongly spinulose 7. *B. macrocarpa*
††† Discoidal or annulate . 8. *B. orbiculata*
** Stipes membranous yellowish
† Stipes long, sporangia iridescent 9. *B. magna*
†† Stipes short or none; iridescent 10. *B. foliicola*
c. Sporangia grey, spores adherent
i. Stipe when present yellowish
† Wall iridescent, spores uniformly marked 11. *B. utricularis*
†† More calcareous, spores strongly marked on one side 12. *B. capsulifera*
††† Colorado, spores anon barred . 13. *B. populina*
ii. Stipe when present black . . . 14. *B. papaveracea*
d. Sporangia brown, lilacine
i. Sessile . . . . . 15. *B. lilacina*
ii. Stipitate, columellate . . . . 16. *B. rubiginosa*

1. Badhamia ovispora *Racib.*

1884. *Badhamia ovispora* Racib., *Myx. Ag. Cracov.*, XII., p. 72.

Sporangia sessile depressed-globose or plasmodiocarpous, white or ochraceous, covered by dense calcareous scales; capillitium white, the lime-granules sometimes aggregate at the center to form a pseudocolumella; spores not adhering, brownish-purple ellipsoidal, 8 × 10–10 × 15 μ.

Reported from Bohemia, England, Pennsylvania.

2. Badhamia versicolor *Lister.*

1901. *Badhamia versicolor* List., *Jour. Bot.*, XXXIX., p. 81.
1911. *Badhamia versicolor* List., *Mycetozoa 2nd ed.*, p. 35.

Sporangia scattered or clustered, minute, .3–.5 mm., grey or flesh-colored, sessile, the calcareous deposits slight; capillitium white or apricot-colored; spores ovoid, 8 × 10–9 × 12 μ, clustered, purplish, and warted at the broader end, elsewhere colorless and smooth.

This little species, as it comes to us, is grey, very uneven in size, .2–.5 mm. and generally irregular in form and habit, perhaps scarce

mature. The capillitium is white, physaroid. The spores furnish the distinguishing character. Sometimes globose, about 9–10. They are most of them definitely and permanently affected in shape by the fact of cluster-association, narrower in the direction of the cluster center. The indications are that these may become globose with maturity.

Colorado, — *Bethel;* Scotland.

3. Badhamia decipiens (*Curtis*) *Berk.*

1848. *Physarum decipiens* Curtis, *Am. Jour. Sci.,* VI., p. 352.
1873. *Badhamia decipiens* Berk., *Grev.,* II., p. 66.
1873. *Physarum chrysotrichum* Berk. & C., Grev. II., p. 66.
1876. *Badhamia chrysotricha* (Berk. & C.) Rost., *App.,* p. 4.

Sporangia gregarious, depressed-spherical or ovate, sessile, occasionally plasmodiocarpous, dull yellow, roughened by the rather large numerous calcareous scales; columella none; capillitium dull orange, strongly calcareous, only slightly widened at the nodes; spore-mass black; spores pale violet, minutely spinulose, free, 10–12 μ.

Among badhamias this and the next species are at once distinguished by the color. If the brief description (*Grev.,* II., p. 66) can be regarded as defining anything, this is the same as *P. chrysotrichum* Berk. & C. It resembles somewhat *P. serpula* Morg., but differs externally in color and in the surface scales, which are not perceptible in the *Physarum.* The present species also resembles *Cienkowskia reticulata* (Schw.) Rost., but has a different capillitium. See under that species.

Chiefly eastern and American. New England, Pennsylvania, Ohio, South Carolina; reported recently also from Sweden and Germany.

4. Badhamia nitens *Berk.*

1852. *Badhamia nitens* Berk., *Trans. Linn. Soc.,* XXI., p. 153.
1863. *Badhamia inaurata* Currey, *Trans. Linn. Soc.,* XXIV., p. 156.
1873. *Badhamia nitens* Berk., Rost., *Mon. App.,* p. 3.

Sporangia gregarious or closely crowded, globose or depressed-

globose, .5–1 mm. in diameter, yellow or greenish yellow, rugulose, sessile; capillitium yellow, forming an open net with occasional thickenings at the nodes; spores clustered, delicately roughened, violaceous-brown, 10–12 μ.

This much resembles the preceding species except in the clustered spores, and more commonly aggregate habit. The spores, as usual when clustered, are conspicuously echinulate on the outer side. This did not escape the notice of the author of the species, *op. cit.*

Colorado, Oregon. Reported from West Indies, Ceylon, various parts of Europe.

5. Badhamia panicea (*Fries*) *Rost.*

1829. *Physarum paniceum* Fries, *Syst. Myc.*, III., p. 141.
1873. *Badhamia panicea* (Fr.) Rost., Fuckel, *Sym. Myc. Nachtr.*, 2, p. 71.

Sporangia gregarious or aggregated in closely compacted clusters, globose or hemispherical, sessile, the peridium thin, transparent, thickly dotted with white calcareous scales; stipe none; columella none, although a pseudo-columella sometimes appears, formed by a more dense development of the capillitium near the centre of the sporangium below; capillitium abundantly developed, quite uniformly thickened, but showing an occasional delicate connecting thread, the nodes also somewhat flattened and enlarged; spore-mass black; spores by transmitted light, bright violaceous-brown, minutely roughened, 10–13 μ. Plasmodium is said to be white.

In America this seems to be a purely western species. Specimens are before us from western Iowa and from Colorado, South Dakota, Nevada, and Southern California. It is very well marked, though liable perhaps to be mistaken at first sight for sessile phases of *P. notabile* or *P. cinereum*. The capillitium is, however, at once determinative. Colorado; *Bethel*. Europe generally.

6. Badhamia affinis *Rost.*

1875. *Badhamia affinis* Rost., *Mon.*, p. 143.

Sporangia aggregated, cespitose and sessile, or sometimes stipitate, depressed above, flat or umbilicate below, the wall grayish white,

rugulose, and more or less calcareous-scaly; the stipe when present erect or sometimes nodding, black or brownish black; hypothallus scanty; columella none; capillitium not abundant, white, the nodes somewhat expanded; spores globose, minutely roughened, violet-brown, large, 16–17 μ.

Chiefly on moss, the pale ashen sporangia generally very small, mounted on the tips of the leaves, sometimes sessile, sometimes with a distinct black stipe in which case the peridium is distinctly umbilicate. Specimens from Kansas referred here have the stipe pale, rugose, long, about twice the sporangium; habitat bark.

Rare. New York, Ohio, Kansas; more recently reported from Scotland and Japan.

There is nothing new to be added here; nor appears any other place to which such material as we have may be referred. New collections no doubt will one day appear, when the identity may, let us hope, be made secure.

Meantime we have a form closely related which may be entered as

BADHAMIA IOWENSIS *Macbr. n. s.*

Sporangia gregarious or loosely scattered, depressed globose, .4–.6 mm. in diameter, stipitate, grey, flecked by rather prominent but small rounded calcareous scales: the stipe short, half the diameter of the sporangium, black or very dark brown, without hypothallus but widening above into a shallow expanded base for the sporangia; columella none: capillitium dull yellow, sometimes white, strongly calcareous, physaroid, heavy; spores free, dark brown in mass, pale violet by transmitted light, minutely verruculose, the tiny warts in some areas more densely placed, producing evident shadowy spots, 10–11 μ.

This interesting little species occurs on the lower surface of fallen logs, blocks, etc., in colonies of considerable extent, hundreds of sporangia in a place. The capillitium is comparable to that of *B. decipiens* or *B. panicea;* it is physaroid to the extent that an occasional filament may be found non-calcic, and not typically badhamioid as in *B. papaveracea, B. macrocarpa.* The sporangial base persists, dark brown, bearing traces of the clumsy capillitium, but no columella

real or simulated. Blackhawk Co., Iowa; *communicavit Dr. Jessie Parish.* See Plate XX., 1, 1 *a*, 1 *b*.

Reddish or roseate forms sometimes appear in colonies otherwise as described. It differs from *B. affinis* in the size and character of the spores, in color and character of the capillitium, habit and surface markings.

7. Badhamia macrocarpa (*Ces.*) *Rost.*

1855. *Physarum macrocarpon* Cesati, *Flora,* XXXVIII., p. 271.
1875. *Badhamia macrocarpa* (Ces.) Rost., *Mon.,* p. 143.

Sporangia scattered or closely aggregate, crowded globose or subglobose, generally sessile, rugulose, white; the peridium membranous, white above, below yellowish or brown; capillitium not abundant, thoroughly calcareous, the nodes broad, conspicuous, the connecting tubules rigid; columella none; hypothallus scant or none; spore-mass black, spores non-adherent, by transmitted light bright clear brown, thickly spinulose all over, large spherical, 12–15 μ.

Closely resembles externally *B. panicea,* but is easily distinguished by larger and remarkably *spinulose* spores, in this particular unrivalled in the entire genus. European authors describe both sessile and stipitate forms. American specimens generally are sessile and for the most part closely crowded, almost heaped; but — Prof. Bethel finds this in winter everywhere on fallen rotting stems of Opuntia and on the bases of dead Yucca leaves, still attached. Associated with the typical phase and often *occurring alone on the Yucca* leaves is a discoidal form which when first sent in (1908) was called var. *gracilis.* Presented alone to one ignorant of its history and associations, it would surely pass for a distinct species. This stalked phase is very delicate; the stipe pale brown, or yellow. See Plate II., Fig. 9. See also Sturgis *Col. Coll. Pub.* XII., 408.

8. Badhamia orbiculata *Rex.*

Plate XIV., Fig. 4.

1893. *Badhamia orbiculata* Rex. *Proc. Phil. Acad.,* p. 372.
1894. *Badhamia macrocarpa Rost.,* Lister, *Mycetozoa,* p. 34 (in part).
1911. *Badhamia orbiculata* Rex., Lister, *Mycetozoa, 2nd ed.,* p. 37.

Sporangia stipitate or sessile, orbicular discoidal, irregularly elongated or plasmodiocarpous, averaging about 1 mm. in width, generally stipitate, and when stipitate, flattened or depressed above, plane or slightly umbilicate below; the peridium simple, more or less translucent from the varying number of innate granules, sometimes covered with circular flat masses of lime, gray except the point of attachment to the stipe which is brown; stipe short, black, rough, plicate; capillitium dense at the centre, radiant at the periphery where it meets the sporangial wall, white; spores violaceous black, minutely warted, 12–15 μ.

This is a beautiful species, easily known by its discoidal or almost annulate sporangia mounted upon short dark black stipes. The stipe in western collections is sometimes very short, but generally suffices to raise the sporangium, a little at least, above the substratum. Sessile and plasmodiocarpous forms do occur with the typical stipitate phase, but may be regarded here as elsewhere as indicative of incomplete development. Plasmodium cream-colored, or pale yellow.

Pennsylvania, Ohio, Iowa, Nebraska, South Dakota, Colorado.

9. Badhamia magna *Peck.*

Plate XIV., Fig. 1.

1871. *Dictydium magnum* Peck, *Rep. N. Y. State Mus.,* XXIV., p. 84.
1879. *Badhamia magna* Peck, *Rep. N. Y. State Mus.,* XXXI., p. 56.
1894. *Badhamia macrocarpa Rost.,* Lister, *Mycetozoa,* p. 34, in part.
1892. *Bahamia varia* Mass. *Mon. Myxog.,* p. 319, in part.
1894. *Badhamia magna* Peck, List., *Mycetozoa,* p. 33.
1899. *Badhamia capsulifera* (Berk.) Macbr., *N. A. S.,* p. 68.
1911. *Badhamia magna* Peck, Lister, *Mycetozoa, 2nd ed.,* p. 34.

Sporangia globose or ellipsoid, .7–1 mm., pale iridescent, stipitate; peridium thin with slight calcareous deposits, rugulose, opening irregularly, white; stipe long flaccid, straw-colored; capillitium an elegant uniform net, its threads stiffened by slight deposits of lime, the nodes little thickened, badhamioid; spores free, dusky with a shade of violet, minutely spinulose, about 10 μ.

This beautiful species closely resembles some forms of *B. utricularis* from which it differs chiefly in its unclustered smooth spores.

B. foliicola as recognized here is hardly more than a smaller, short-stemmed form of this; see species next following.

Not rare in the eastern United States and Canada; Iowa. Seems to take the place of *B. capsulifera* of Europe.

10. Badhamia foliicola *Lister.*

1897. *Badhamia foliicola* List., *Jour. Bot.,* XXXV., p. 209.
1911. *Badhamia foliicola* List., *Mycetozoa, 2nd ed.,* p. 34.

"Plasmodium orange." Sporangia smaller, about .5–.6 mm., globose or ellipsoidal, iridescent-gray, stipitate or sessile, the peridium thin, rugulose, sparingly calcareous, when empty white; the stipe when present short but yellowish, of the flaccid sort; capillitium badhamioid; spores free, delicately spinulescent, dusky-violaceous, about 12–13 μ.

This has been so far collected but once, on the shores of Lake Okoboji. It was developed, no doubt, on the natural débris of a bur-oak prairie border, and went to fruit on the leaves, stems, and fruiting spikes of a species of *Setaria.* It may prove to be different from the *B. foliicola* of Europe; future collections and study must reveal that. Meantime it seems wise to refer it here.

The color of the plasmodium is quoted from Miss Lister; a fact of some importance only when constant and confirmed by other criteria.

Iowa; Toronto,—*Miss Currie.*

11. Badhamia utricularis (*Bull.*) *Berk.*

1791. *Sphaerocarpus utricularis* Bull., *Champ.,* p. 128, t. 417, Fig. 1.
1826. *Physarum utriculare* Chev., *Fl. Paris,* I., p. 337.
1829. *Physarum utriculare* Fries, *Syst. Myc.,* III., p. 139.
1852. *Badhamia utricularis* (Bull.) Berk., *Tr. Linn. Soc.,* XXI., p. 153.

Sporangia clustered, spherical or ovoid, large, sessile or mounted on long, thin, strand-like stalks, blue-gray, violet-iridescent or cinereous, smooth or more often rugulose; the stipes when present poorly differentiated, as if thread-like filaments and strips of the plasmodium, often branched and always reclining or even prostrate; hypothallus none;

capillitium a large-meshed open network of rather slender tubules, the nodes unequally developed, white with the enclosed lime; spores not strictly adherent though not without some tendency to stick together, delicately warted, bright violet-brown, 10–12 μ.

This species resembles *B. capsulifera,* but is distinguished by a more strongly rugulose less calcareous peridium and a more profuse development of filamentous stipes, but especially by the character of the spores. The spores of the present species while inclined, when mounted in a liquid, to stay together, nevertheless do not coalesce in heaps as in the related species, nor do they show any differentiation in the episporic markings, these being uniform over the entire spore.

This is one of the finest and perhaps the most beautiful species of this fine genus. It is a forest species, generally to be found on trunks of fallen *Populus* or *Tilia* where the fine soft gray colonies often spread for several inches along the ridges and in crevices of the bark.

Colorado (*Bethel*); Mississippi valley and east.

12. Badhamia capsulifera (*Bull.*) *Berkeley.*

1791. *Sphaerocarpus capsulifer* Bull., *Champ.,* p. 139, t. 470, Fig. 2.
1801. *Physarum hyalinum* Pers., *Syn. Meth. Fung.,* p. 170.
1852. *Badhamia capsulifera* Berk., *Tr. Lin. Soc.,* XXI., p. 153.
1852. *Badhamia hyalina* Berk., *Tr. Lin. Soc.,* XXI., p. 153.
1875. *Badhamia hyalina* (Pers.) Rost., *Mon.,* p. 139.
1875. *Badhamia capsulifera* (Bull.) Rost., *Mon.,* p. 141.
1894. *Badhamia hyalina* Lister, *Mycetozoa,* p. 30.
1911. *Badhamia capsulifera* Lister, *Mycetozoa, 2nd ed.,* p. 31.

Sporangia clustered or gregarious, sessile or sometimes stipitate, globose or obovoid, gray or greenish white, snow-white when empty; the peridium thin, translucent; the stipe, when present, as in *B. utricularis,* although generally shorter and better developed, yellow or straw colored; capillitium a very loose, open network of white, lime-filled tubules, not much expanded at the nodes; columella none; spore-mass purplish-brown; spores adhering in clusters of five or six to twenty or more, globose, but affected somewhat by mutual pressure, rough throughout, the exposed surface in the cluster, more distinctly warted, 10-12 μ.

This is *Badhamia hyalina* (Pers.) Berk., Rost., *Mon.*, p. 139; but Rostafinski himself admits that the two species, here united, as he defined them, are very much alike, having "the same spores and capillitium", differing in the form of the sporangium, an inconstant feature. Bulliard's name has precedence; his descriptions of this and the preceding species are remarkable.

The peculiarly adherent spores distinguish the species from *B. utricularis;* and the sporangia sessile or with short but strand-like stipes, distinguish it from *B. papaveracea.*

The description above is for the typical European form. Lister expresses doubt whether this occurs in the United States. The form from Iowa which is the basis for the inclusion of the species in N. A. S. is, we believe, nothing else than *B. capsulifera* (Bull.) Berk. The form approaches *B. populina* as this is presented in Colorado. The Iowa specimens are white, aggregate, superimposed, etc., but have the capillitium and spores exactly as described for the type. Accordingly *B. populina* as this occurs in Colorado has been for years referred to the Berkeley species. The thicker more strongly calcareous peridia constitute, as would appear, the principal difference in the forms from Colorado. See next species.

13. Badhamia populina *List.*

1904. *Badhamia populina* List. *Jour. Bot.*, XLII., p. 129.
1911. *Badhamia populina* List. *Mycetozoa, 2nd ed.*, p. 32.

Plasmodium white; sporangia sessile, crowded, heaped, large, 1.5 mm., rarely stipitate, globose or ovoid, white; stipe when present brown; capillitial strands broad, calcareous; spores clustered, 16–20 in a cluster, purple-brown, roughened and sometimes marked by obscure ridges and bands, 10-12 μ.

Generally distinguishable by its unusually large calcareous, white sporangia. The peridia are strongly calcareous, shell-like in texture. In some case the color is tinted with rose.

This species is very near *B. capsulifera* as recognized in the United States. When white the Colorado material corresponds almost exactly with the forms collected in Iowa, and regarded as representing the

species just named. The Colorado gatherings are more strongly calcareous and the spores sometimes present the variations named. "The Colorado phase of the American form."

Colorado,— *Bethel.* Europe?

14. Badhamia papaveracea *Berk. & Rav.*

Plate IX., Figs. 6, 6 *a*, and 6 *b*.

1873. *Badhamia papaveracea* Berk. & Rav., *Grev.*, II., p. 66.
1894. *Badhamia hyalina* var. *papaveracea* Lister, *Mycetozoa*, p. 30.
1899. *Badhamia papaveracea* Berk. & Rav., Macbr., *N. A. S.*, p. 69.
1911. *Badhamia papaveracea* Berk. & Rav., List., *Mycetozoa, 2nd ed.*, p. 32.

Sporangia gregarious, globose, large, stipitate, iridescent-gray; the peridium thin, translucent, and containing but little calcareous deposits, smooth or slightly rugulose; stipe very short, but generally distinct, black or very dark brown; hypothallus none; capillitium a network of large meshes with expanded nodes, prominent, white, persistent after the spores have been blown away; spore-mass deep brown; spores adherent as in *B. capsulifera,* marked in much the same way, and about the same size, 10–12.5 μ.

Distinguished by its short, dark, stipe and adherent spores.

Not common. New England, Pennsylvania, Ohio, Maryland, South Carolina, Wisconsin, Iowa.

15. Badhamia lilacina (*Fries*) *Rost.*

1829. *Physarum lilacinum* Fries, *Syst. Myc.*, III., p. 141.
1875. *Badhamia lilacina* (Fries) Rost., *Mon.*, p. 145.
1892. *Craterium lilacinum* Mass., *Mon.*, p. 271.
1894. *Badhamia lilacina* (Fr.) Rost., Lister, *Mycetozoa*, p. 34.
1911. *Badhamia lilacina* (Fr.) Rost., List., *Mycetozoa, 2nd ed.*, p. 38.

Sporangia globose, sub-globose, or obconical, sessile, gregarious or more or less clustered, supported by a thin, continuous, transparent hypothallus; the peridium smooth pale, lilac-brown without, white within; stipe none, although some sporangia have a narrowed base; columella none, the pseudo-columella formed by a more densely aggregated capillitium near the base; capillitium dense, white, strongly

nodulose; spore-mass black; spores dark, violaceous-brown by transmitted light, distinctly warted, or reticulate, the reticulations resembling somewhat those of some of the trichias, as *T. affinis,* 10–15 μ.

Easily recognizable, generally at sight, by its peculiar color. White forms, however, occur; often lilac-tinted and white from the same plasmodium. A perfectly white colony seems to be rare. Both colors are shown in specimens distributed. *N. A. F.,* 2494.

Common eastward, Ontario, New England, Pennsylvania, Ohio, etc. Not reported west of the Mississippi River.

Whatever the color, the spores are in every case positively diagnostic. The episporic markings are unlike those of any other species in the present order. Dr. Rex describes some New York forms as provided with a short but distinct stipe. Such forms resemble externally *Scyphium rubiginosum* (Chev.) Rost. The hypothallus is also unique. V. next species.

16. Badhamia rubiginosa (*Chev.*) *Rost.*

Plate X., Figs. 1, 1 *a,* 1 *b,* 1 *c.*

1826. ***Physarum rubiginosum*** Chev., *Fl. Par.,* p. 338.
1872. ***Craterium obovatum*** Peck, *Rep. N. Y. Mus.,* XXVI., p. 75.
1875. ***Scyphium rubiginosum*** (Chev.) Rost., *Mon.,* p. 148.
1876. ***Badhamia rubiginosa*** (Chev.) Rost., *Mon. App.,* p. 5.
1892. ***Craterium rubiginosum*** Massee, *Mon.,* p. 270.

Sporangia gregarious, obovoid, grayish brown, stipitate, the peridium simple, membranous, above thin, pale, more or less calcareous below, more persistent blending with the stipe; stipe erect, reddish brown or purplish, expanded below into a small hypothallus, above, prolonged within the sporangia more than half its height as a definite columella; capillitium very dense, snow white, long persistent with the lower two-thirds of the sporangial wall; spore-mass dark brown; spores by transmitted light, dark violet or purple-brown, minutely roughened or spinulose, not adherent, 12-14 μ.

This is probably the most common badhamia in the country and in the world. It is found every year, in the woods, on masses of decaying leaves, especially those of various species of oak. The plasmodium is yellow. The fructifications are very distinct, not likely

to be mistaken for those of any other species; the stipes constitute a very prominent feature in every gathering I have seen. Sometimes these are more or less coalescent, especially toward the base, where they are apt to be also wrinkled or longitudinally striate; in other specimens the stipes are well differentiated, long, terete, with little or no hypothallus.

Badhamia curtisii (Berk.) Rost. is according to Lister (Mon., p. 35) a sessile phase of this species. The only specimens known are in the herbarium of Berkeley, now at Kew. The species is based upon a gathering from S. Carolina. Berkeley thought it a didymium, called it *D. curtisii.*

Reported from western Europe; the typical form abundant in the forested regions of eastern N. America, especially in the Mississippi valley.

17. Badhamia subaquila *Macbr.*

1899. *Badhamia subaquila* Macbr., *N. A. S.,* p. 64.

Sporangia closely gregarious or crowded, globose or subglobose, sessile, brown, the peridium a thin but persistent brown membrane, rupturing above irregularly and remaining as a cup after spore dispersal; hypothallus none; capillitium strongly developed, thoroughly calcareous, the meshes large, the nodular thickenings broad, white; spores globose, in mass black, by transmitted light brown, very roughwarted, large, 15-18 μ.

The variety is founded on material sent from Maine by the late Mr. F. L. Harvey. Professor Harvey, upon the authority of Mr. Morgan of Ohio, quotes the species, *Bull. Tor. Bot. Club,* 24, 67, as *B. verna* (Somm.) Rost. But the specimens certainly do not conform to description of *B. verna.* Here the wall corresponds with what is seen in *B. rubiginosa;* but the spores are much larger, and the capillitial structure very different.

Miss Lister regards this a form of No. 16. So far, the original gathering represents the species; but the woods of Maine are certain one day to send added information.

Rare. On mossy logs, Maine.

3. Physarum (*Persoon*) *Rost.*

1794.[1] *Physarum* Pers., *Röm. Neu. Mag. f. d. Bot.,* I., p. 88, in part.
1795. *Physarum* Pers., *Ust. Ann. Bot.,* XV., p. 5, in part.
1801. *Physarum* Pers., *Syn. Fung.,* p. 168, in part.
1829. *Physarum* (Pers.) Fries, *Syst. Myc.,* II., p. 127, in part.
1875. *Physarum* (Pers.) Rost., *Mon.,* p. 93.

Sporangia plasmodiocarpous, æthalioid or distinct; the peridium usually simple, sometimes double, irregularly dehiscent, more or less definitely calcareous; capillitium a uniform irregular net, dilated and calcareous at the nodes, adherent on all sides to the peridial wall.

This large and cosmopolitan genus is readily recognized by the characters quoted. It may be added that the capillitial threads are always exceedingly delicate, probably tubular, but never filled with lime throughout; the peridium may be almost nude or encrusted with lime, which, where present, is always amorphous, never crystalline; the sporangia when distinct may be either sessile or stipitate, and the stipe in the latter case is often hollow and charged with lime. In capillitium intermediate between *Leocarpus* and *Badhamia,* since in the first the capillitium is unequally calcareous, diverse, while in *Badhamia* the capillitium is intricate and calcareous throughout.

As first set up by its founder, the genus included diverse forms, only one or two of which would be included in the genus as now limited.[2] Persoon, however, was left to develop the matter to suit himself, and in successive works gave, under this generic name, more and more prominence to forms now so referred. Fries, *Syst. Myc.,* III., pp. 127 *et seq.,* still better establishes the genus, though still including forms that, judging from the description, seem to belong elsewhere. Twenty years later Fries revising somewhat his earlier work thought to improve the chances of future students by reducing the number of physarums. This he would do by setting out certain evidently inter-related forms to make a new genus, *Tilmadoche.*

[1] Prior to Persoon the physarums were variously referred: *Lycoperdon, Sphaerocarpus, Trichia,* etc. It seems unnecessary to quote the synonymy further here.

[2] Persoon's first-named species is *P. aureum;* see *Römer Neu. Mag. f. d. Bot.,* I., p. 88. 1794.

He named two or three species only, leaving his sucessors to add others as occasion offered.[1]

Rostafinski approved the good intention of Fries, but in the *Monograph,* he entirely re-cast the genus as constituted by Fries; actually called the species 'first cited' a typical physarum! Would not have it in the new genus at all, first or last; but instead took the second species of Fries as the type and added several forms, some from the Friesian list, to make up a respectable group.

Until quite recently writers on the subject have generally approved the course adopted by the Polish author. The arrangement showed features of convenience, even if artificial to a degree. Perhaps we gain advantage in all directions if we treat the original genus *Physarum* as a whole, but in the key take advantage of Fries' suggestion. We may write —

Key to the Species of Physarum

1. Capillitium irregularly reticulate throughout; calcic nodes various *Physarum*
2. Capillitium more regular, especially below, furcate; nodes fusoid *Tilmadoche*

SECTION I. PHYSARUM

I. Fructification not stipitate, more or less plasmodiocarpous.
  1. Peridium simple.
    a. Calcareous deposits yellow . . . 1. *P. serpula*
    b. Calcareous deposits reddish or orange . 2. *P. lateritium*
    c. Calcareous deposits white, peridium rugulose . 3. *P. vernum*
  2. Peridium double.
    a. Fructification flatly compressed . . 4. *P. sinuosum*
    b. Fructification less compressed, rounded.
      i. Outer peridium white . . . 5. *P. bitectum*
      ii. Outer peridium brown or brown-tinged 6. *P. bogoriense*
      iii. Outer peridium yellow; capillitium yellow 7. *P. alpinum*

[1] Fries (*Sum. Veg. Scand.,* p. 454) described the new genus in the following words: Tilmadoche. Fr. Physari spec. S. M. Peridium simplex, tenerrimum (*Angioridii*) irregulariter rumpens. Capillitium intertexto-compactum, a peridio solutum liberum, sporisque inspersis fuscis. Columella o.
1. T. leucophæa. Fr.
2. T. soluta. (Schum.)
3. T. cernua. (Schum.)

II. Fructification of sporangia more or less distinct.
A. Sporangia sessile, globose, ovoid, reniform, etc.
1. Peridium double.
a. Sporangia white, peridium testaceous . 8. *P. diderma*
b. Sporangia tinged with yellow.
i. Sporangia as if interwoven, compressed
9. *P. contextum*
ii. Sporangia more nearly free, distinct.
* Spores pale, inner peridium brittle
10. *P. conglomeratum*
** Spores spinulose, dark violet 11. *P. mortoni*
c. Sporangia brown, dehiscence revolute 12. *P. brunneolum*
2. Peridium simple, calcareous, flaky.
a. Sporangia grey, plasmodiocarpous; spores dusky, 10–12 forms of 3
b. Sporangia grey, more or less dense; spores violet, 6-7
13. *P. cinereum*
c. Calcareous deposits yellow or greenish, spores 7-9
14. *P. virescens*
d. Sporangia rusty or reddish brown, more or less dense
15. *P. rubiginosum*
e. Sporangia minute, lignicolous, the fructification much extended upon a hypothallus, lime deposit tawny
16. *P. instratum*
f. Sporangia white, depressed, annulate, sometimes with short stipes . . . . 17. *P. megalosporum*
3. Peridium simple, not flaky, small .2–.3 mm., heaped
18. *P. confertum*
B. Sporangia, at least some of them, stipitate.
a. Sporangia columellate.
i. Columella small, usually conical.
* Sporangium yellow.
° Columella white . . 19. *P. melleum*
°° Columella yellow . . 20. *P. citrinum*
** Sporangium not yellow.
° Capillitial mass persistent.
† Sporangia globose, pallid or white
21. *P. globuliferum*
†† Sporangia blue or lilac, rose, etc.
22. *P. lilacinum*
††† Sporangia drab or brownish
23. *P. murinum*
†††† Sporangia wine-red 24. *P. pulcherrinum*
°° Capillitial-mass less persistent; orange
25. *P. pulcherripes*
ii. Columella long, 4–5 the sporangium non-calcareous.
26. *P. penetrale*
iii. Columella large globose . . 27. *P. luteo-album*

b. Sporangia without columella.

i. Sporangia nucleate, calcareous at center.

* Stipe yellow . . . . 28. *P. nucleatum*

** Stipe white . . . . 29. *P. wingatense*

ii. Sporangia non-nucleate.

* Sporangia purple . . . 30. *P. newtoni*

** Sporangia blue, spotted with red 31. *P. psittacinum*

*** Grey or white, iridescent betimes.

° Sporangia white, discoidal; stipe yellow 32. *P. discoidale*

°° Sporangia lightly calcareous, iridescent, subglobose, diam. about = to the stout, brown, slightly wrinkled stipe 33. *P. leucophaeum*

°°° Sporangia globose or sub-globose.

x. Small, .5 mm.

† Stipe erect, clear brown 34. *P. nodulosum*

†† Stipe weak, yellow, stuffed 35. *P. maculatum*

xx. Larger, lime-capped; stipe strand-like 36. *P. didermoides*

xxx. Stipe snow-white, fragile 37. *P. leucopus*

xxxx. Stipe generally distinctly fluted

† Sporangia laterally compressed, fan-shaped 38. *P. compressum*

†† Sporangia typically globose, umbilicate below, connate, etc., strongly calcareous 39. *P. notabile*

††† Sporangia reniform, concave below *P. affine,* see under 38

†††† Sporangia larger, to 1 mm., nearly limeless, iridescent 40. *P. tropicale*

°°°° Sporangia obovate, compound, clustered, the stipe fuscous, fluted, short. 41. *P. nicaraguense*

**** Sporangia yellow, rarely iridescent or brown.

° Capillitial nodes white.

x. Stipe also white 42. *P. sulphureum*

xx. Stipe flesh-colored, spores smaller 43. *P. carneum*

xxx. Stipe red or reddish brown 44. *P. citrinellum*

xxxx. Stipe yellowish, flaccid, sporangia leocarpine 45. *P. albescens*
xxxxx. Stipe very short or none, sporangia cylindric, brown 46. *P. variabile*

°° Capillitium nodes yellow or orange-yellow.
x. Badhamioid, larger, — to .8 mm. 47. *P. auriscalpium*
xx. Physaroid, base persistent 48. *P. oblatum*

°°° Capillitium nodes pure yellow.
x. Capillitial threads yellow 49. *P. galbeum*
xx. Capillitial threads hyaline 50. *P. tenerum*
xxx. Peridium iridescent.
† Capillitium persistent 51. *P. flavicomum*
†† Capillitium less persistent, larger . 52. *P. bethelii*

SECTION II. TILMADOCHE

I. Æthalioid, gyrose or irregular . . . . . 53. *P. gyrosum*
II. Fructification stipitate.
1. Sporangia irregular, often convolute, involved 54. *P. polycephalum*
2. Sporangia simple, nutant, discoidal.
a. Thin-walled, grey or white . . . 55. *P. nutans*
b. Vari-colored, yellow, greenish, orange, etc. 56. *P. viride*

1. PHYSARUM SERPULA *Morgan.*

PLATE IX., Figs. 6, 6 *a*, and 6 *b*.

1831. *Physarum reticulatum* Alb. & Schw., Schweinitz, *N. A. F.*, No. 2295.
1885. *Physarum gyrosum* (Rost.) Wingate, Ellis, *N. A. F.*, No. 1396.
1892. *Physarum gyrosum* Rost., Massee, *Mon.*, p. 307.
1892. *Cienkowskia reticulata* Rost., Macbr., *Bull. Nat. Hist. Iowa*, II., 2, p. 150.
1894. *Badhamia decipiens* Berk., Lister, *Mycetozoa*, p. 33, in part.
1896. *Physarum serpula* Morg., *Cin. Soc. Nat. Hist.*, p. 101.
1899. *Physarum serpula* Morg., Macbr., *N. A. S.*, p. 29.
1911. *Physarum serpula* Morg., Lister, *Mycetozoa, 2nd ed.*, p. 81.

Plasmodiocarp repent, reticulate, forming anon lines, circles, dots, etc., venulose pale yellow, ochraceous, at length whitish, the peridium thin, membranaceous, simple, fragile, but withal persistent, below

united with a hypothallus which is more or less widely produced; capillitium rather scant, but abundantly charged with polygonal nodules of lime, yellow; spore-mass black; the spores, by transmitted light, violaceous, warted, globose, 10–13 μ. Plasmodium, at maturity, greenish-yellow.

A very distinct species not likely to be confused with anything else, although in description, so far as concerns external characters, suggesting *Cienkowskia reticulata.* The two forms are not at all alike when placed side by side. For details as to the difference, see the description of the species last mentioned.

Apparently not rare in eastern United States, Pennsylvania, Virginia, Ohio, Iowa.

In 1805, Albertini and Schweinitz, *Conspectus Fungorum,* p. 251, t. 7, Fig. 2, described as *Physarum reticulatum,* a European form which became the basis of Rostafinski's genus *Cienkowskia;* see under that genus. Later, 1829, Schweinitz discovered in America a physarum-looking specimen which he took to be the same thing, and accordingly placed in his herbarium under this name, and entered *N. A. F.* 2295. Rostafinski further re-named another Schweinitzian species *Fuligo muscorum* calling it, *Mon.,* p. 111, *Physarum gyrosum.* Wingate and Rex apply in Ellis, *N. A. F.,* this latter name to No. 2295 of Schweinitz. Such a reference is a mistake, judging from Rostafinski's descriptions and from the description and figure of Albertini and Schweinitz (*Consp. Fung.,* p. 86, t. 7, I), and by the testimony of Lister. For further concerning Rostafinski's species, see under *Physarum gyrosum,* p. 111, *Mon.*

2. Physarum lateritium (*Berk. & Rav.*) Rost.

1873. *Didymium lateritium* Berk. & Rav., *Grev.,* II., p. 65.
1875. *Physarum ditmari lateritium* Rost., *Mon., App.,* p. 9.
1879. *Physarum inequale* Peck, *Rep. N. Y. Mus.,* XXXI., p. 40.
1892. *Physarum chrysotrichum* Berk. & C., Massee, p. 300.
1894. *Physarum inequale* Peck, Lister, *Mycetozoa,* p. 60.
1896. *Physarum lateritium* (Berk. & Rav.) Morg., *Jour. Cin. Soc.,* p. 95.
1899. *Physarum lateritium* (Berk. & Rav.) Morg., Macbr., *N. A. S.,* p. 33. p. 33.
1911. *Physarum lateritium* Morg., List., *Mycetozoa, 2nd ed.,* p. 82.

Plasmodium scarlet. Sporangia gregarious, sessile, globose or subglobose, or sometimes plasmodiocarpous, yellowish or orange, everywhere, when fresh, spotted with minute scarlet granules; the peridium thin, more or less rugulose; columella none; capillitium delicate, generally yellow, with nodules conspicuous, yellow or reddish; spores violet-brown in mass, by transmitted light pale violet, minutely roughened, 7-9 μ.

A well-marked species easily recognized by the characters cited. The extent of lime deposit at the capillitial nodes varies; sometimes very little. This accounts for Berkeley's generic reference. On the other hand, Lister makes the rounded lime knots "each knot with a red centre surrounded by yellow, round, lime-granules" diagnostic. This pied condition does not come out in any of our specimens. The capillitium in broken specimens soon fades, tends to white, etc.

New York, Pennsylvania, Ohio, Colorado, and south. Ceylon, Java, Brazil.

3. PHYSARUM VERNUM *Somm.*

1829. *Physarum vernum* Somm., Fries, *Syst. Mycol.,* III., p. 146.
1875. *Physarum cinereum* (Batsch), Rost., *Mon.,* p. 102, in part.
1875. *Badhamia verna* Rost., *Mon.,* p. 145.
1894. *Badhamia panicea* Rost., List., *Mycetozoa,* p. 34.
1899. *Physarum cinereum* (Batsch) Rost., Macbr., *N. A. S.,* p. 34 (in part).
1911. *Physarum vernum* Somm., Lister, *Mycetozoa, 2nd ed.,* p. 75.

"Plasmodium white." Sporangia sessile, generally plasmodiocarpous white, nearly smooth; peridium more or less testaceous not scaly, but breaking irregularly; capillitium densely calcareous, the nodules angular, branching, sometimes united to form a pseudo-columella; spores dusky violaceous, rough, 10–12 μ.

Sommerfeldt's description quoted by Fries, *l. c.,* evidently concerned a less calcareous phase. Fries by his annotation relieves somewhat the reader's uncertainty.

Rostafinski calls this a badhamia but describes a physarum, and the form has, as is believed, been consistently confused with *P. cinereum* by every student of the group from the days of DeBary until now. In the second edition of the *Mycetozoa,* Lister clears the situation

by transferring the species to *Physarum,* and calling attention to spore-dimensions. The fact is, the species in external appearance so much resembles *P. cinereum,* that the unaided eye cannot distinguish one from the other. Curiously enough, Rostafinski describes the form he had before him as "one of the rarest." Doubtless had he gone back to his specimens of *P. cinereum* he had found plenty, for in Europe it seems abundant everywhere. In this country it is *P. cinereum* as now defined, that is rarer, although not uncommon. From all connection with *Badhamia,* as representing *B. panicea* it should, as would appear, be withdrawn once for all.

4. Physarum sinuosum (*Bull.*) *Weinm.*

Plate VIII., Figs. 6 and 6 *a,* and Plate XIX, Fig. 15.

1791. *Reticularia sinuosa* Bulliard, *Champ.,* p. 94; t. 446, Fig. 3.
1796. *Physarum bivalve* Persoon, *Obs. Myc.,* I., p. 6; t. III., Fig. 2.
1828. *Physarum sinuosum* Wein., Fries *teste, l. c.*
1828. *Angioridium sinuosum* Grev., *Scot. Crypt. Fl.,* 310.
1829. *Physarum sinuosum* Fries, *Syst. Myc.,* III., p. 145.
1875. *Physarum sinuosum* (Bull.) Rost., *Monograph,* p. 112.
1892. *Physarum sinuosum* Rost., Massee, *Mon.,* p. 305.
1894. *Physarum bivalve* Pers., Lister, *Mycetozoa,* p. 57.
1896. *Angioridium sinuosum* (Grev.), Morg., *Cin. Soc. Nat. Hist.,* p. 75.
1899. *Physarum sinuosum* (Bull.) Wein., Macbr., *N. A. S.,* p. 28.
1911. *Physarum sinuosum* Wein., Lister, *Mycetozoa, 2nd ed.,* p. 76.

Sporangia distinct or plasmodiocarpous, the plasmodiocarp creeping in long vein-like reticulations or curves, laterally compressed; sometimes distinct and crowded, always sessile. Peridium double; the outer thick, calcareous, fragile, snow-white; the inner delicate, the dehiscence by more or less regular longitudinal fissure. Capillitium strongly developed with abundant white, calcareous granules. Spores smooth, dull violet, 8–9 μ. Plasmodium pale gray, or nearly white.

Easily recognized at sight by its peculiar form, bilabiate and sinuous. Apart from microscopic structure, perfectly described by Fries, *Syst. Myc.,* p. 145. Bulliard called it *Reticularia sinuosa.* Habitat various, but not infrequently the upper surface of the leaves of living plants, a few inches from the ground. The two sorts of fructification often occur side by side, or merge into one another from the

same plasmodium. Where the substratum affords room the plasmodiocarpous style prevails; in narrower limits single sporangia stand. The calcareous deposit on the peridium is usually very rich and under a lens appears made up of countless snowy or creamy flakes. Forms occur, however, in which these outer calcic deposits are almost entirely wanting; the peridium becomes transparent, the capillitium visible from without. Judging from material before us, this appears to be the common presentation in western Europe. See also No. 5 following.

Widely distributed. New England to the Carolinas, and Louisiana west to South Dakota and Nebraska, Iowa and Washington.

5. Physarum bitectum *List.*

Plate XIX., Fig. 16.

1891. *Physarum diderma* Rost., List., *Jour. Bot.,* XXIX., p. 260.
1894. *Physarum diderma* Rost., List., *Mycetozoa,* p. 57.
1911. *Physarum bitectum* List., *Mycetozoa, 2nd ed.,* p. 78.

Sporangia gregarious, subglobose, sessile or plasmodiocarpous, smooth white or pallid, terete or somewhat compressed; peridium double, the outer wall calcareous, free and deciduous above, recurved and persistent below; the inner, smooth, pale purplish, more persistent; dehiscence more or less irregular beginning at the top; capillitium of large white nodules connected by short hyaline threads; spores generally spinulose, violaceous brown, 9-10 μ.

As suggested by the author of this species it is properly a variety of *P. sinuosum;* certainly is, as it presents itself in this part of the world. Of the species last named we have compressed forms opening by narrow fissure along their knife-edged summit, with scarce place for capillitium at all between the approaching walls; again we have colonies of sporangia quite terete, calcareous without, opening in fragmental fashion at the top, displaying sometimes the thin membranous inner wall but at length fissured and gaping as in the more usual phase figured by authors, where the plasmodiocarp is simply compressed but not extravagantly thin. Both types occur in the western mountains, forms with and without calcium, fissured by wider or narrower cleft, *from the same plasmodium;* forms bilabiate and

forms opening at first to display an inner peridium; forms globose with narrow base, but apex cleft, and forms ellipsoidal, yet compressed, opening like the gaping of some tiniest bivalve; did not Persoon say *P. bivalve!* all are bivalvular at the last! Nay; but what are these? Here are some of the shorter forms become suddenly obovate, and are actually mounted on *stipes!* Surely variation in the same plasmodium can no farther go![1]

Not rare. Colorado to the Pacific Coast. Evidently a western-American variation of Bulliard's European type. The latter occurs abundantly in Iowa on the shores of Lake Okoboji; otherwise not common.

6. Physarum bogoriense *Racib.*

1898. *Physarum bogoriense* Raciborski, Hedw., XXXVII., p. 52.

Sporangia sessile, elongate, creeping but not reticulate, semicircular in transverse section, sometimes globose or depressed globose; peridium double, the outer thick coriaceous, yellow or brown, dehiscing stellately into persistent more or less triangular reflected lobes, remote from the thin, colorless inner wall; columella none; capillitium feebly developed, the nodes white, large, isodiametric; spores bright violet, smooth, 7-8 μ.

This species is not uncommon in the mountains of Colorado where it has been taken at various stations by Bethel. It is reported from Pennsylvania and South Carolina. Raciborski describes it from Java.

In habit it is very much like some forms of *P. sinuosum* but differs in the depressed, rather than compressed sporangia, and in the brown color of the outer peridium.

7. Physarum alpinum *G. List.*

1910. *Physarum alpinum* G. Lister, *Jour. Bot.*, XLVII., p. 73.

Sporangia globose and sessile or plasmodiocarpous, dull yellow, smooth or scaly; peridium double, the outer wall densely calcareous, separating irregularly from the membranous inner wall; capillitium

[1] See also *Inaug. Diss.*, H. Rönn, *Schr. d. Naturw. Ver. f. Schl. Holst.*, XV., Hpt. I., p. 55, 1911.

densely calcareous, the nodes large, more or less branched, yellow; spores purple brown, closely and minutely warted, 9–14 μ.

This species is based by its author upon a gathering made in California by Dr. Harkness and named by Phillips who received it in England, *badhamia inaurata*. He seems not to have described it. Since its first appearance, the form has been found repeatedly in the Juras. Specimens are before me from Mt. Rainier believed to be the same. The plasmodiocarpous habit and yellow capillitium separate this from related *P. contextum* and *P. mortoni*.

Europe, California, Washington.

8. PHYSARUM DIDERMA *Rost.*

PLATE XVIII., Fig. 9.

1875. *Physarum diderma* Rost., *Mon.*, p. 110.
1898. *Physarum didermoides* var. *lividum* List., *Jour. Bot.*, XXXVI., p. 162.
1899. *Physarum diderma* Rost., Macbr., *N. A. S.*, p. 30.
1911. *Physarum testaceum* Sturgis, List., *Mycetozoa, 2nd ed.*, p. 79.

Sporangia snow-white, clustered, sessile or narrowly adnate, globose or polygonal by mutual compression; peridium double, the outer dense, fragile, thick, calcareous, the inner delicate, remote, translucent, capillitium well developed, the calcareous nodules white, rounded or angular, sometimes uniting to form a pseudo-columella; spore-mass black; spores purplish, distinctly rough, 10–12 μ.

A beautiful and distinct species. As others in the group with which it is here associated, it is a physarum with the outward seeming of a diderma. It occurs in Europe, therefore it is safe to assume that Rostafinski saw it. So well marked it is that any good description will define it, and Rostafinski describes it perfectly, adequately.[1]

Mr. Lister having used for another species the name we here apply — see under *P. bitectum* — referred this present form to *P. dider-*

[1] Inasmuch as there has been decided difference of opinion in reference to this particular species,—all judges readers of the same original description,—it has seemed wise to submit an English translation from the celebrated *Monograph loc. cit.*

"24. Physarum diderma *Rfski.*

"Sporangia sessile, globose, adnate by a narrow base, white. Peridium double; the outer thick, strongly calcareous, very distinctly set off from the

moides Rost., *l. c.* Professor Sturgis, convinced that such reference was at least doubtful, gave to our American gatherings the distinctive name above, citing specimens from Massachusetts, from Colorado, and from California. Curiously enough he also includes specimens of *R. didermoides* var. *lividum* List., sent from England!

Rare! Certainly rare in Europe and so far seldom seen in the United States, though widely distributed. Specimens are before us from Ohio, Michigan, Iowa, Oregon. No doubt the mountains of the north Pacific coast, a region to-day almost unsearched, will yet afford the species in abundance.

As stated Mr. Lister first applied the name *P. diderma* to a plasmodiocarpous form occurring in England and near *P. sinuosum*. More lately, *Mon., 2nd ed.,* p. 78, he adopts a new specific name, *P. bitectum* for the English specimens, and enters *P. diderma* as a probable synonym for *P. lividum* R. Evidently our present form as described above has not come to Mr. Lister's view. He says the original type is not to be consulted.

There is really no more merit in this later comparison than in that discarded. The species *P. diderma* is not *P. lividum,* but stands as originally delimited, and will, doubtless, some day yet again appear in its own behalf upon the witness-stand of time; when, as before, a Frenchman in DeBary's old-time haunts may rise to give it welcome, brought back by some keen-eyed Polish student eager now in the arts of peace, from Warsaw's shady groves.

9. Physarum contextum *Persoon.*

Plate IX., Figs. 3 and 3 *a.*

1796. *Diderma contextum* Persoon, *Obs. Myc.,* I., p. 89.
1801. *Physarum contextum* Persoon, *Syn. Meth.,* p. 168.

thin inner one by an air-filled space; the calcareous nodules many, angular, loosely developed within to form a pseudo-columella; spores dark violet, spinescent, 9.2-10 in diameter.

"*Opis.* This physarum looks extremely like a diderma.

"The sporangia stand either aggregated or bunched together in heaps of five to twelve, adnate to the hypothallus by a narrow base, etc."

Massee, *Mon.,* p. 304, translated this description, but misunderstood what is said of the columella and is inclined to think the author did not know a diderma when he saw one; which is pretentious, to say the least!

1829. *Diderma contextum* Persoon, Fries, *Syst. Myc.*, III., p. 111.
1873. *Diderma ochroleucum* Berk. & C., *Grev.*, II., p. 52.
1879. *Diderma flavidum* Pk., *N. Y. Rep. State Mus.*, XXXI., p. 55.

Sporangia distinct, sessile, densely crowded, sub-rotund reniform more often elongate, interwoven; peridium double; the outer rather thick, calcareous, yellow, or yellowish white, the inner thin, yellowish; capillitium white, containing numerous large, irregular calcareous granules; columella none; spores deep violet, 11-13 μ, covered with minute spinules.

This singular species occurs not rarely upon the bark of fallen twigs, upon bits of straw or grass-stems lying undisturbed upon the ground. In such a position the slime-mould covers, as with a sheath, the entire substratum. The outer peridium, especially its upper part, is entirely evanescent, our Fig. 3 shows the sporangia with upper outer peridium wanting. Not rare in summer and autumn.

New England, New York, Pennsylvania, Ohio, Wisconsin, Illinois, Iowa, Colorado, Oregon, Nicaragua.

10. Physarum conglomeratum (*Fr.*) *Rost.*

1803. *Spumaria granulata* Schum., *Enum. Pl. Saell.*, II., p. 196, No. 1419.
1803. *Spumaria minuta* Schum., *l. c.*
1829. *Diderma granulatum* Schum., Fries, *S. M.*, III., p. 110.
1829. *Diderma minutum* Schum., Fries, *l. c.*, p. 111.
1829. *Diderma conglomeratum* Fries, *l. c.*, p. 111.
1875. *Physarum conglomeratum* (Fr.) Rost., *Mon.*, p. 108.
1892. *Physarum rostafinskii* Massee, *Mon.*, p. 301.
1894. *Physarum conglomeratum* Rost., Lister, *Mycetozoa*, p. 58.
1899. *Physarum conglomeratum* (Fr.) Rost., Macbr., *N. A. S.*, p. 31.
1911. *Physarum conglomeratum* Rost., List., *Mycetozoa, 2nd ed., p.* 80.

Sporangia depressed, globose, or irregular, sessile, more or less aggregated, ochraceous-yellow, peridium double, the outer, thick, cartilaginous, at length irregularly ruptured, and reflexed, disclosing the more delicate, ashen-gray, inner membrane which encloses capillitium and spores; capillitium abundant, showing large, white irregular calcareous thickenings which are often consolidated in some sporangia tend to aggregate at the centre; spore-mass brown, spores violaceous, slightly roughened, 8–10 μ.

This beautiful species shows a peridium as distinctly double as in

any diderma. The outer peridium is reflexed exactly as in some species of that genus; is yellow without, white within, and withal long persistent. The capillitium of course distinguishes the species instantly as a physarum. By the size of the spores it is distinguished from the species preceding. This being a decisive specific character the synonymy prior to Rostafinski is somewhat uncertain. The specific name adopted by the Polish author is therefore approved, although perhaps not the earliest.

Rare. The only specimens thus far are from Tennessee and Louisiana.

11. Physarum mortoni *Macbr. n. s.*

Plate XX., Figs. 2, 2 *a.*

Sporangia gregarious, clustered but distinct, sessile small, about .75 mm., bright yellow, peridium double. The outer rough, breaking up into comparatively few rather large deciduous scales, the inner peridium white, calcareous, both persisting below to form a distinct cup; capillitium lax, the nodes white, large, angular; columella none; hypothallus none; spores distinctly rough, dark brown with the usual purple shadow, 10–12 μ.

A very distinct little species related, no doubt, to *P. contextum,* but different in habit. It is never crowded, shows no plasmodiocarpous tendencies, while the outer peridium is generally deciduous except at the base and falls in flakes.

Collected several times in the Three Sisters Mountains of Oregon by *Professor Morton E. Peck.*

12. Physarum brunneolum (*Phillips*) *Mass.*

Plate XX., Figs. 7, 7 *a.*

1877. *Diderma brunneolum* Phillips, *Grev.,* V., p. 114.
1888. *Diderma brunneolum* Phill., Saccardo, *Syll. Fung.,* No. 1292.
1892. *Physarum brunneolum* Phill., Massee, *Mon.,* p. 280, Figs. 221–222.
1894. *Craterium pedunculatum* Lister, *Mycetozoa,* p. 71.
1911. *Physarum brunneolum* Mass., Lister, *Mycetozoa, 2nd ed.,* p. 63, Pl. 69, Fig. *a.*

Sporangia scattered or gregarious, but not crowded, sessile, glo-

bose or sub-depressed; peridium double, thick, smooth or polished, yellow brown, stellately dehiscent, the segments reflexed, white within; columella none; capillitium dense, with nodes numerous, large irregular, internodes thin and short; spores globose, lilac, minutely warted, 6-7 μ.

This form was first described in *Grevillea,* V., p. 114, as *Diderma brunneolum* Phillips. Later, students of the specimens preserved by Mr. Phillips, concur that we have to do not with a diderma, but with a craterium, Lister, or physarum, Massee. There seems no reason why we should not respect the decision of Massee, whose description is here quoted in form somewhat abridged. The peridium is about as double as in the many physarums, not more so; the inner membrane so delicate as only occasionally to be revealed except to scrutiny most searching. But the appearance as a whole is as of some brown diderma; only the calcareous capillitium abides to prevent mistaken reference.

When opened by irregular dehiscence from above, the persisting cup-like base of the sporangium recalls *Leocarpus fragilis;* but then again the capillitium is different.

California, Portugal; Colorado,—*Sturgis.*

13. Physarum cinereum (*Batsch*) *Pers.*

Plate IX., Figs. 4, 4 *a*, 4 *b*.

1786. *Lycoperdon cinereum* Batsch, *Elench. Fung.,* p. 249, Fig. 169.
1801. *Physarum griseum* Link, *Diss.,* I, p. 27.
1805. *Physarum cinereum* Persoon, *Synopsis,* p. 170.
1829. *Didymium cinereum* Batsch, Fries, *Syst. Myc.,* III., p. 126.
1829. *Physarum plumbeum* Fries, *Syst. Myc.,* III., p. 142.
1875. *Physarum cinereum* Batsch, Rost., *Mon.,* p. 102, in part.
1896. *Physarum plumbeum* Fr., Morgan, *Myx. Mi. Val.,* p. 98.
1899. *Physarum plumbeum* Fr., Macbr., *N. A. S.,* p. 35.
1909. *Physarum cinereum* (Batsch) Pers., Torrend, *Flore des Myx.,* p. 183.

Plasmodium watery white, or transparent, wide streaming on decaying sod, etc. Sporangia sessile, closely gregarious, or even heaped, sub-globose, elongate or plasmodiocarpous, more or less calcareous, gray; peridium simple, thin, more or less densely coated with lime; capillitium strongly developed, the nodes more or less richly

calcareous, the lime-knots rounded, angular; spore-mass brown, spores clear violaceous-brown, 6–7μ, distinctly warted.

This delicate, inconspicuous species is well defined by the characters given. It occurs not rarely on richly manured ground, in meadows, lawns, or even on the open prairie. The plasmodium may form rings several inches in diameter, scattered here and there over a surface several square feet in extent, in fruit ascending the blades of grass, completely covering these with the crowded sporangia. The color of the fruit is well described in the specific name; gray or ashen gray. The spores are very distinctly papillate; in some specimens, however, almost smooth; in few instances, rough.

Common. New England west to the Black Hills and Pacific coast. Cosmopolitan.

The present species well illustrates the difficulty confronting the author of to-day who, discussing a group of microscopic organisms, would fain use the nomenclature of his predecessors, honored, but equipped with insufficient lenses. Here is a species reported common in Europe, observed by every mycologist there, from Micheli down, and yet awaiting adequate description until Rostafinski in his great book, gives the results of microscopic analysis. We are now really dealing with *P. cinereum* Rost; *P. cinereum* Batsch is a compliment to certain rather clever water-color drawings.

Rostafinski gives a long list of synonyms, none, it is believed, represent American forms; and without taking careful thought, surely no one would rudely disturb such honorable interment; but, in his description the range of spore-measurement, 7–13.3 μ, gives us pause, and raises the suspicion that possibly, in one case or another, the sepulture were perhaps premature. The range is too great! Perhaps, in the series offered in confirmation, small-spored forms represent one species, large-spored, something else?

European students may decide this at their leisure. But Rostafinski having, not without much labor, practically completed his review of the physaroid forms had almost finished the last genus *Badhamia,* when his mind perhaps returned, no doubt with some lingering misgivings, to the thirteenth species in his physarum list. There were there, he recalled, some large-spored specimens which

had rather badhamioid capillitium. The sessile physarums of Fries were also before him, those especially, "floccis albis." Of these one shall be *B. panicea,* one *B. lilacina* and one *B. verna,* described as having rather delicate colorless capillitial tubes combined in a loose net, the calcareous deposits about the enlarged intersections scanty, the spores 12.5 μ.

The description of the fructification as a whole is a condensed statement of that which describes *P. vernum,* and all taken together indicates some physarum. See now No. 3 preceding, p. 51.

P. plumbeum Fr. belongs here. It has similar spores, the only difference is a less calcareous peridium and more scattered habit of fructification with more nearly regular, depressed-globose sporangia.

P. cinereum Pers. as cited by Link, *op. cit.,* is apparently a badhamia, may be *P. vernum,* while *P. griseum* is probably the present species.

14. Physarum virescens *Ditmar.*

Plate VIII., Figs. 7, 7 *a,* 7 *b.*

1817. *Physarum virescens* Ditmar, Sturm, *Deutsch. Fl. Pilze,* I., p. 123, Pl. 61.
1875. *Physarum ditmari* Rost., *Mon., App.,* p. 8.
1892. *Physarum ditmari* Rost., Macbr., *Bull. Lab. Nat. Hist. Ia.,* II., p. 155.
1894. *Physarum virescens* Ditmar, Lister, *Mycetozoa,* p. 65.
1909. *Physarum virescens* Ditmar, Torrend, *Flo. d Myx.,* No. 207.
1911. *Physarum virescens* Ditmar, Lister, *Mycetozoa, 2nd ed.,* p. 83.

Sporangia sessile, crowded or heaped in small bunches, a dozen or more sporangia in one pile, spherical, ovoid or elongate, yellow or greenish yellow; peridium thin, fragile; capillitium delicate, with rather small, irregular, yellowish, calcareous nodes; columella none; spores bright violet, minutely roughened, 7–9 μ.

This species occurs more commonly on moss-tufts, with which it is frequently con-colorless, or escaped on dead leaves, etc. The peridium is flecked with calcareous scales or grains stained yellow or green, and to these the whole fruit owes its peculiar color. The color and aggregate, heaped sporangia are distinctive macroscopic characters.

In the *Monograph,* p. 113, Rostafinski adopted properly Ditmar's name for this species. Upon later consideration, in the *Appendix,*

p. 8, he changed the name, writing *P. ditmari,* on the ground that *virescens* was descriptive of a character to which the species in question occasionally refuses to conform. Most authors since Rostafinski have simply accepted his suggestion, so that the species is often entered *P. ditmari* Rost. *P. virescens* is certainly to be preferred. *N. A. F.,* 2692.

Canada, New England, New York, Pennsylvania, Ohio, Iowa, Black Hills, South Dakota.

15. Physarum rubiginosum *Fries.*

1817. ***Physarum rubiginosum*** Fries, ***Symb. Gast.,*** **p. 21.**

Plasmodium scarlet. Sporangia globose or cylindric, sessile or sometimes narrowed to a stem-like base as if short-stipitate, olivaceous brown with sometimes a flush of red; the peridium simple, thin rugulose or plain, the calcareous scales few, or apparently included; columella none; capillitium dense, the nodules rather large, angular, rusty brown; spores dull violaceous, gently roughened, about 10 μ.

A beautiful well-marked species, but evidently rare in North America. Our only typical specimens are from the gatherings by Mr. Wingate, part of which is by Lister referred to this species, *Mycetozoa, 2nd ed.,* p. 82.

P. rubiginosum Fr. in the *N. A. S.,* 1899, is based on certain west coast specimens now known as *Badhamia decipiens* Berk.

In Colorado there occurs a plasmodiocarpous form of the species. It has the characteristic spore and capillitium but in form and habit differs very decidedly. The fructification is a delicate netted plasmodiocarp, the tubule about .5 mm., bright red; the peridium simple, cartilaginous, dehiscent from above, and flecked with just here and there a red calcareous scale.

Collected at Palmer Lake; *Professor Bethel.*

16. Physarum instratum *Macbr. n. s.*

1899. *Physarum thejoteum* Macbride, *N. A. S.,* p. 36, not Fries, as cited.
1911. *Physarum virescens* Ditmar, Lister, *Mycetozoa, 2nd ed.,* p. 83.

Sporangia very small, closely crowded on a delicate, more or less

visible hyphothallus, often connate, but not superimposed, sub-spherical, dull orange, brownish or tawny; peridium thin, violaceous, covered with very minute yellow calcareous scales; columella none; capillitium lax, sometimes almost wanting; the nodules small, yellowish or brownish, occasionally confluent; spore-mass violaceous, spores by transmitted light, violet-tinted, smooth or nearly so, 6-7 μ.

Not uncommon in the Mississippi valley, where it sometimes is passed by the collector as an immature form of some other species. The appearance is very characteristic, unlike *P. virescens* in both habit, size, and color. Colonies are quite often three inches in length. The most common habitat seems to be rotten oak, especially fragments of charred logs, etc.

Ohio, Illinois, Missouri, Iowa, Nebraska.

This species presents a decidedly well-marked form, so much so that it may be easily recognized at sight, without a lens. It therefore requires special discussion, and although in the spore-characters and some minor but not determinative details it agrees with *P. virescens* Ditm. to which it is by European authors sometimes referred, it seems nevertheless deserving of specific recognition, since in its entire habit and expression it is not only completely different but is constant in its specific peculiarities, much more so than is the suggested related form.

In the first edition of this work, the form was referred to *Physarum thejoteum* of Fries. This was the judgment of our American colleague, Professor A. P. Morgan whose work in this group is widely recognized. Fries admits, *Syst. Myc.,* III., p. 142, that while he deems *P. thejoteum* very distinct, he yet has not seen *P. virescens* Ditm.! Since our form apparently does not occur in Europe, specimens which the distinguished author had before him were doubtless representatives of the now commonly recognized species of Ditmar.

For these reasons it seems appropriate to give the American type a suitably descriptive title.

17. Physarum megalosporum *Sturg.*

Plate XVI., Figs. 7 and 7 *a.*

1917. *Physarum megalosporum* Sturgis, *Mycologia,* Vol. IX., p. 3.

Sporangia gregarious, sessile, or short stipitate depressed, annulate, or at least umbilicate above, white or anon roseate, about .75 mm; stipe, when present, short, thick, black or dark brown! hypothallus none; columella none; capillitium strongly calcareous, an abundance of irregular white nodules burden the delicate net; spores dark sooty brown with a shade of purple by transmitted light, verruculose, 12-13 μ.

This species is recognizable at once by its regular, uniform, depressed, annulate or pitted sporangia, scattered evenly over the habitat of rotten leaves or wood. It suggests a didymium in its form and habit, but is near a badhamia. Colorado; *Bethel,* 1908.

18. Physarum confertum *Macbr. nom. nov.*

Plate XV., Figs. 1, 1 *a*, 1 *b*.

1899. *Physarum atrum* Schw., Macbr., *N. A. S.*, p. 36.
1911. *Physarum atrum* Schw., Lister, *Mycetozoa, 2nd ed.*, p. 74.

Sporangia small about .2-.3 mm. in diameter, gregarious, confluent, clustered or heaped, dull violaceous brown; peridium thin, more or less transparent, generally limeless but sometimes lightly sprinkled with minute white flecks: capillitium scanty, the calcareous nodes small, rounded, elongate, white! columella none; spores violet-brown, distinctly warted, 10-12 μ.

Having been assured on information believed trustworthy that the Schweinitzian herbarium confirmed the identity of the species before us, in the first edition of this work the form was listed as *P. atrum* Schw. Meantime in the herbarium referred to, at Philadelphia the original type of *P. atrum* still exists. My valued correspondent, Mr. Hugo Bilgram, has recently given it careful study. It is a limeless *P. didermoides* (Pers.) R.! Small wonder we have had trouble! Exit *Physarum atrum* Schw.

The species is not uncommon, especially eastward; has been generally ignored for reasons cited.

Distinguished from everything else by the color and small size of the heaped sporangia. It resembles some phase of *P. virescens* where the sporangia are small and somewhat heaped or rather aggre-

gated, and scantily supplied with lime; but in such case the lime is yellow and the spores are small.

This species has also been constantly referred to our confused *P. cinereum, P. plumbeum,* etc., but Schweinitz, who certainly had seen *P. cinereum* in Europe, since he cites it, under several forms, in the *Conspectus,* found the species in America and proceeded in Pennsylvania in December to find something else, very different as he thought, and in fact. He called this new discovery *P. atrum,* "beautifully *reticulate",* he says "like *P. cinereum* but larger."

Most American students in an effort to keep faith with their pioneer mycologist, have taken cue from the specific name, looking for something *black,* heedless that in Pennsylvania almost any delicate thing has 'dark looks' in the middle of the winter! Berlese in Saccardo *Syll.* VII., p. 350, regarding *P. atrum* as a synonym, writes for the black American specimens, *P. reticulatum,* emphasizing another Schweinitzian descriptive adjective. But *P. atrum* Schw. has had place in literature to this hour.

19. Physarum melleum *(Berk. & Br.) Mass.*

1873. *Dydymium melleum* Berk. & Br., *Jour. Linn. Soc.,* XIV., p. 83.
1873. *Didymium chrysopeplum* Berk. & C., *Grev.,* II., p. 53.
1876. *Physarum schumacheri* Spr. var. *melleum* Rost., *Mon., App.,* p. 7.
1892. *Physarum melleum* Massee, *Mon.,* p. 278.
1896. *Cytidium melleum* (Berk. & Br.), Morg., *Jour. Cin. Soc.,* p. 83.
1899. *Physarum melleum* (Berk & Br.) Mass., Macbr., *N. A. S.,* p. 47.
1911. *Physarum melleum* Mass., Lister, *Mycetozoa, 2nd ed.,* p. 46.

Sporangia scattered, stipitate, globose, flattened below, clear yellow or honey colored; stipe short, about equaling the sporangium, pure white, somewhat wrinkled; columella small but distinct, white; hypothallus none, capillitium abundant, open, snow-white, with rather large angularly stellate nodes; spore-mass brown, almost black; spores by transmitted light, pale violet or lilac-tinted, almost smooth, 7.5-10 μ.

Easily distinguished by its white stipe, columella and capillitium in contrast with yellow peridial walls. *N. A. F.,* 1395. Massee refers this number erroneously to *P. schumacheri Rost.* The description

and specimen do not correspond. By that name the species has however, been hitherto known in the United States.

Eastern United States, common; rare west of the Mississippi.

Reported from Brazil, Japan and the tropic islands round the world. Portugal.

20. Physarum citrinum *Schumacher.*

1803. *Physarum citrinum* Schum., *Enum. Pl. Saell.,* II., p. 201.
1911. *Physarum citrinum* Schum., List., *Mycetozoa, 2nd ed.,* p. 51.

Sporangia gregarious, scattered, globose, somewhat flattened below, pale yellow, citrine, stipitate; the peridium thin, covered almost completely with small calcareous scales; stipe stout, erect, fragile, tapering upwards, furrowed, opaque, arising from a small hypothallus which is anon continuous from one sporangium to the next; columella small, conical, yellow; capillitium a rather dense, delicate network, the calcareous nodules yellow, numerous, roundish, and generally small; spore-mass black; spores under the lens violaceous, almost smooth, about 8 μ.

This species seems to be rare in the United States. It resembles somewhat *P. melleum*, from which it is distinguished by its yellow stipe. *P. galbeum* is a smaller form, and lacks the columella. Rostafinski strangely confused the synonymy here, including even *P. rufipes* Alb. & Schw.

New England, Ohio, Colorado.

21. Physarum globuliferum *(Bull.) Pers.*

1791. *Sphaerocarpus globuliferus* Bull., *Champ.,* Pl. 484, Fig. 3.
1801. *Physarum globuliferum* Pers., *Syn.,* p. 175, T. III., Figs. 10, 11, 12.
1829. *Diderma globuliferum* Fries, *Syst. Myc.,* III., p. 100.
1876. *Physarum petersii farlowii* Rost., *Mon., App.,* p. 6.
1879. *Physarum albicans* Peck, *Rep. N. Y. Mus.,* XXX., p. 50.
1893. *Physarum columbinum* Macbr., *Bull. Lab. Nat. Hist. Iowa,* II., 384.
1899. *Physarum globuliferum* (Bull.) Pers., Macbr., *N. A. S.,* p. 45.
1911. *Physarum globuliferum* Pers., Lister, *Mycetozoa, 2nd ed.,* p. 48.

Sporangia gregarious, stipitate, globose, or slightly depressed above, pale blue-gray or pure white; stipe sometimes equal to the sporangium, generally longer, slender, slightly wrinkled, white, or yellow, pallid,

when longer tapering upward; columella white, conical, sometimes obsolete; hypothallus none; capillitium dense, but delicate, persistent, a close network of hyaline threads, with white or yellowish nodes sparingly thickened and calcareous, many without lime; spore-mass brown; spores by transmitted light, violet, minutely warted, 7.5–9 μ. Plasmodium greenish-yellow.

This species, very common eastward, rare west of the Mississippi, is at once very beautiful and very variable. Its several phases have been again and again observed and described too often by distinct specific or varietal names. A form from New York, with long, white stems and almost pure white sporangia, is *P. albicans* Peck. Forms occur like *P. albicans*, but flushed wih *rose* throughout. From New England, specimens sent Rostafinski were by him deemed a variety of *P. petersii* Berk. & C., and called *P. petersii* var. *farlowii* Rost. By this name the species has been generally distributed in this country. *N. A. F.,* 1120. Most gatherings of this species have small, somewhat ochraceous, sporangia, and pale yellow, or somewhat rusty, stipes. These latter, with somewhat heavier stem, represent *Physarum simile* Rost. A form collected sparingly in Iowa has short, white stipes and blue gray sporangia one-third larger than observed in the eastern types. This was recorded, *l. c.,* as *P. columbinum* Macbr.; name already in use. The spores in the Iowa specimens are also a little larger, 8-10 μ. Pale cyanic and roseate forms also sometimes occur in late fruitings; see next species.

In all phases the persistent tenacity of the capillitium is a striking characteristic well noticed by Fries (*l. c.,* p. 101): "Peridia a gleba omnimo libera, dein tota diffracta, evanescentia, . . . capillitio compacto forma servata persistente." The peridium, except a small part below, all falls away, leaving the capillitium apparently intact, crowded with spores.

From England to Iowa; Canada, south to Louisiana and Mexico; apparently, in one form or another, cosmopolitan.

22. PHYSARUM LILACINUM *Sturgis & Bilgram.*

1917. *Physarum lilacinum* Sturg. & Bilg., *Mycologia,* Vol. IX., p. 3.

Sporangia gregarious, stalked, globose, erect, pale-lilac to pale

Indian-red in color, 0.5 mm. in diameter; sporangium-wall membranous, beset with rounded masses of lilac or reddish lime. Stipe erect, broad-based, tapering upwards, calcareous, furrowed, paler than the sporangium or concolorous, 0.7–0.9 mm. long, about 0.1 mm. thick, columella conical or columnar, capillitium delicate, rigid, persistent; lime-knots small, rounded, composed of large, pale lilac, or reddish, spherical granules. Spores pale-brown, almost smooth, 8–9 μ.

23. Physarum murinum *Lister.*

1894. *Physarum murinum* Lister, *Mycetozoa,* p. 41.
1899. *Physarum ravenelii* (Berk. & C.) Macbr., *N. A. S.,* p. 48.
1911. *Physarum murinum* Lister, *Mycetozoa, 2nd ed.,* p. 50.

Sporangia scattered, globose or perfectly spherical, ashy-brown, rugulose, stipitate; stipe elongate, pale brown, erect, generally tapering upward, calcareous, brittle; hypothallus none; columella short, hemispherical or bluntly conical; capillitium dense, much as in *P. globuliferum,* the calcareous nodules, umber, brownish or orange-yellow, small; spore-mass brown; spores by transmitted light, bright lilac, almost smooth, 7–9 μ.

A very distinct species, easily known by its peculiar drab-colored peridium and dull brown stalks. The author of the species allows for the capillitial nodes none other tint but brown. Under direct illumination many gatherings, especially where the sporangia are well blown out, show nodules of a bright orange tint.

Not rare in the eastern United States, to Missouri and Iowa. Reported also from western Europe.

Mr. Lister finds *Didymium ravenelii* Berk. & C., on which *P. ravenelii* (Berk. & C.) Macbr. is founded, referable to *P. pulcherripes* Pk.

24. Physarum pulcherrimum *Berk. & Rav.*

1873. *Physarum pulcherrimum* Berk. & Rav., *Grev.,* II., p. 65.
1875. *Physarum pulcherrimum* (Berk. & Rav.) Rost., *Mon.,* p. 105.
1879. *Physarum atrorubrum* Peck, *Rep. N. Y. Mus.,* XXXI., p. 40.
1899. *Physarum pulcherrimum* Berk. & Rav., Macbr., *N. A. S.,* p. 49.
1911. *Physarum pulcherrimum* Berk. & Rav., Lister, *Mycetozoa, 2nd ed.,* p. 50.

Plasmodium dark red. Sporangia scattered or gregarious, globose, even, or somewhat wrinkled, dark red, stipitate; stipe cylindric, even, sub-concolorous or blackish; columella small or none; capillitium free from spores, whitish, with a slight pinkish tinge; spores dark brown in mass, dark red when separated, globose, smooth, 7.5–8.5 μ.

The capillitium is very delicate, and when cleared of spores the knot-like thickenings are seen to be very small and of a dark red color, to which is probably due the pinkish tinge which marks the whole. A part only of the thickenings are filled with lime granules. The dark red granules of the sporangium walls are abundant and appear to form a continuous crust.

This is *P. atrorubrum* Peck, and his description, *l. c.,* has been closely followed. The very brief description in *Grevillea,* however, antedates the New York publication and, all inadequate as it is, no doubt applies to the same thing.

Not rare. New York, Pennsylvania, Ohio, Missouri, Iowa.

25. Physarum pulcherripes *Peck.*

1805. *Physarum aurantiacum* var. *rufipes* Alb & Schw., *Consp. Fung.,* p. 94.
1829. *Diderma rufipes* (Alb. & Schw.) Fries, *Syst. Myc.,* III., p. 101.
1873. *Physarum pulcherripes* Peck., *Bull. Buff. Soc. Nat. Hist.,* I., p. 64.
1873. *Didymium erythrinum* Berk., *Grev.,* II., p. 52.
1873. *Didymium ravenelii* Berk. & C., *Grev.,* II., p. 53.
1873. *Physarum petersii* Berk. & C., *Grev.,* II., p. 66.
1875. *Physarum schumacheri* Spr. var. *rufipes* Alb.& Schw.,Rost.,*Mon.,* p. 99.
1894. *Physarum pulcherripes* (Peck), Lister, *Mycetozoa,* p. 41.
1896. *Cytidium rufipes* (Alb. & Schw.) Morg., *Jour.Cin.Soc. Nat.Hist.,* p. 81.
1899. *Physarum rufipes* (Alb. & Schw.) Morg., Macbr., *N. A. S.,* p. 50.
1911. *Physarum pulcherripes* Peck., List., *Mycetozoa, 2nd ed.,* p. 49.

Sporangia gregarious, dark-colored, sprinkled with orange flakes of lime, globose, the wall thin, deciduous, stipitate; stipe slender, erect, deep red, sometimes black below, pale or orange above, and supported on a well-developed hypothallus; columella scant or none; capillitium dense, the meshes and nodes unusually small and delicate, the latter reddish or yellow; spore-mass black; spores by transmitted light, violet-tinted, 8-10 μ., almost smooth.

The striking contrast of color between sporangia and stipes renders this species at sight, quite distinct from any related form. The

peridia in the specimens before us are black or iridescent-black sprinkled more or less profusely with orange lime granules which sometimes cover all but the base. The stipe, springing from a small hypothallus, is dark red below for about one-fourth its height, then vermillion, above expanding slightly beneath the peridium; the columella scant or none. The capillitium is an elegant delicate net, with numerous small, uniformly regular, calcareous nodes, orange; by transmitted light, yellow. The spores, brown in mass, are, by transmitted light, pale violet, slightly papillose, 8–10, mostly about 8 μ. The plasmodium is probably yellow.

This species is no doubt related to *P. psittacinum*. It is, however, much smaller, has a calcareous stipe, and a much less variegated peridium, and generally a small columella.

It is also akin to *P. globuliferum* and to *P. murinum, P. petersii* Berk. & C. is reported the same thing.

26. Physarum penetrale *Rex*.

Plate XV., Figs. 6, 6 *a*.

1891. *Physarum penetrale* Rex., *Proc. Phil. Acad.*, p. 389.
1899. *Physarum penetrale* Rex., Macbr., *N. A. S.*, p. 55
1911. *Physarum penetrale* Rex., List., *Mycetozoa, 2nd ed.*, p. 36.

Sporangia scattered, erect, stipitate, generally ellipsoidal, pyriform, rarely globose; peridium membranaceous semi-transparent, studded sparsely with rounded, pale yellow or yellow-gray lime-granules, rupturing to the base into two or four segments; stipe variable, slender, subulate, rugulose, flattened laterally toward the base, translucent, dull red or golden red in color; columella four-fifths the height of the sporangium, concolorous with the stipe, acuminate; capillitium dense, persistent, the nodes frequently calcareous, rounded, yellow; spore-mass brown, spores nearly smooth, brownish, 6–7 μ.

Readily recognizable by the elongate sporangia and the lengthened columella unique among physarums. The capillitial nodes are at first pale yellow, but tend to whiten on exposure. The spores when highly magnified show delicate spinulescence.

Maine, New York, Pennsylvania, Ohio, Europe, Java.

27. PHYSARUM LUTEO-ALBUM *Lister*

1904. *Physarum luteo-album* List., *Jour. Bot.*, XLII., p. 130.
1911. *Physarum luteo-album* List., *Mycetozoa, 2nd ed.*, p. 48.

Sporangia gregarious, subglobose, large, about 1 mm. in diameter, yellow shading into white, orange or olivaceous, smooth or rugulose, stipitate; stipe stout, smooth, .5-1 mm. high, yellow or orange above, white below, cylindric, lime-stuffed; columella large, subglobose or clavate, yellow; capillitium either of very slender pale yellow, threads, branching at acute angles and anastomosing or of broad, yellow simple or forked strands, persistent after spore-dispersal; nodules few, small, linear or fusiform; spores purple-brown, spinulose, 10-12 μ.

This species, originally described from England and northern Europe has more recently been identified in material sent by Professor Sturgis from Colorado. In description the form is well marked; evinces apparently great variation alike in form, color, and structure.

The material we have, however, is poor, badly weathered.

The general plan of structure corresponds very well with Fries' idea of his genus Tilmadoche, although the present species would seem, by very grossness, strangely out of place with the tilmadoches. But the singular, didermoid, evenly branching, threads of the capillitium, bearing their slender spindle-shaped burdens of lime are very suggestive; it is a diderma gone wandering into the camp of the physarums if one may judge from Miss Lister's graphic plate.

The specific name selected for this peculiar form has once before done service, but apparently for something quite dissimilar. Schumacher; *Enum. Pl. Saell.* II., p. 199, has *P. luteo-album*. Fries thinks he had a perichæna on hand; at any rate, not a physarum, and makes Schumacher's combination a synonym for *Perichaena quercina* Fr., which Rostafinski in turn makes synonymous with *P. corticalis* (Batsch) R. If "once a synonym always a synonym" be esteemed good taxonomic law, this species must one day have another name. The present author, unwilling to change his colleague's preference in this case, nevertheless begs to suggest that such a binomial as *P. listeri* would probably at once make future history of the species less eventful, and honor the memory of England's latest and most distinguished student of the group he loved.

28. Physarum nucleatum *Rex.*

1891. *Physarum nucleatum* Rex., *Proc. Phil. Acad.*, p. 389.

Sporangia gregarious, spherical, ½ mm., white, stipitate; peridial wall membranaceous, rupturing irregularly, thickly studded with rounded white lime-granules; stipe about 1 mm., subulate, yellowish-white, rugose; columella none, capillitium dense, snow-white, with minute, white, round or rounded nodes, in the centre a conspicuous mass of lime forming a shining ball, not part of the stipe although sometimes produced toward it; spore-mass black; spores brown-violet, delicately spinulose, 6–7 μ.

This species most nearly resembles in appearance and habit of growth *P. globuliferum* Pers., but may be distinguished from it by the absence of a columella, by the central ball of lime, and the very small rounded lime-granules in the meshes of the capillitium. Exceptionally the lime granules of the sporangium wall are sparse or absent entirely, in which case the wall has a silvery or coppery metallic lustre.

Pennsylvania, Nicaragua.

29. Physarum wingatense *nom. nov.*

Plate XVI., Figs. 3, and 9.

1876. *Tilmadoche columbina* (Berk. & C.) Rost., *Mon., App.*, p. 13 (?).
1889. *Tilmadoche compacta* Wing., *Proc. Acad. Nat. Sci.*, p. 48.
1894. *Physarum compactum* List., *Mycetozoa*, p. 45.
1896. *Physarum compactum* (Wing.) Morg., *Jour. Cin. Soc.*, p. 91.
1899. *Tilmadoche compacta* Wing., Macbr., *N. A. S.*, p. 61.
1916. *Physarum columbinum* (Rost.) Sturg., *Mycologia*, Vol. VIII., p. 4.

Sporangia gregarious, or somewhat crowded, erect or cernuous, stipitate, gray or brownish gray, globose; peridium thin, metallic brown or bronze in color, splitting at maturity in floriform manner into six to twelve segments; stipe white or yellowish white, often shading to black or fuscous below, rather long, tapering upward; hypothallus none; columella none; capillitium extremely delicate, white or colorless, radiating from a central lime-mass or nucleus, and with ordinary nodules small and few, fusiform; spore-mass

brown; spores by transmitted light, violet-brown, delicately warted, 7-8 μ.

This species is well marked by several characteristics; the brilliant wall of the peridium, white-flecked and laciniate, the delicate *Didymium*-like capillitium running from centre to peridium, and especially the peculiar aggregation of lime at the center of the sporangium, like nothing else except a similar structure found in *Physarum nucleatum* Rex. The variations affect the stipe and the distribution of the capillitial lime. Some eastern specimens show stipes melanopodous, black below; specimens from Ohio and Nicaragua show stipes milk-white throughout. As to the capillitium, in some of the Nicaragua collections the lime is more uniformly distributed through the capillitium, and accordingly the nucleus is not conspicuous, its place being taken by two or three nodes plainly larger than the others. The peculiar brown metallic lustre of the peridial wall, and the strongly developed calcareous patches with which the peridium is covered are constant features.

That this is the *Didymium columbinum* Berk., or *T. columbina* (Berk.) Rost., is very doubtful; the specific name given by Wingate becomes inapplicable when the series is transferred to *Physarum,* since in that genus the combination is already a synonym. See *P. compactum* Ehrenberg, *Syl. Myc. Berl.,* p. 21 (1818), cited repeatedly in the synonymy; Fries, *op. cit.,* Vol. III., p. 101. So also *P. columbinum, l. c.,* pp. 133, 135, etc., to say nothing of the fate of Persoon's first record, *Obs. Mycol. pars prim.,* p. 5, 1796 This is Wingate's species, let it bear his name.

30. Physarum newtoni *Macbr.*

Plate XIV., Figs. 5, 5 *a*, 5 *b*.

1893. *Physarum newtoni* Macbr., *Bull. Lab. Nat. Hist. Iowa,* II., p. 390.
1899. *Physarum newtoni* Macbr., *N. A. S.,* p. 37.
1911. *Physarum newtoni* Macbr., Lister, *Mycetozoa, 2nd ed.,* p. 54.

Sporangia simple, gregarious, short-stipitate or sessile, globulose or flattened, when not globose, depressed and deeply umbilicate above, purple, smooth, thin-walled, stipe when present very short and concolorous; columella none; hypothallus none; capillitium abundant,

delicate, with more or less well-developed nodules, which are also concolorous; spores by transmitted light, dark brown, thick-walled, rough, nucleated, about 10 μ.

A very handsome little species collected by Professor G. W. Newton in Colorado, at an altitude of several thousand feet. Easily recognized by its almost sessile, rose purple, generally umbilicate sporangium.

31. Physarum psittacinum *Ditm.*

1817. *Physarum psittacinum* Ditm., Sturm, *Deutsch. Fl. Pilze,* p. 125.
1829. *Physarum psittacinum* Ditm., Fries, *Syst. Myc.,* III., p. 134.
1873. *Physarum psittacinum* Ditm., Rost., *Mon.,* p. 104.
1911. *Physarum psittacinum* Ditm., Lister, *Mycetozoa, 2nd ed.,* p. 55.

Sporangia scattered or gregarious, globose or depressed-globose, or reniform, iridescent-blue, mottled with various tints, red, orange, yellow, white, stipitate; stipe equal, or tapering slightly upward, rugose, orange or orange red, without lime, rising from a small concolorous hypothallus; columella none; capillitium dense, crowded with calcareous, brilliant orange nodules which are angular in outline and tend to aggregate at the centre of the sporangium; spore-mass brown; spores by transmitted light, pale brown, slightly but plainly warted, about 10 μ. *N. A. F.,* 2492.

Differs from *P. pulcherripes* Pk. in external coloration, the peridium a rich blue, mottled but not with lime; in the capillitium, dense, calcareous, with large angular or branching nodes; in the stipe without lime; in the spores, a little larger than in *P. pulcherripes,* and by transmitted light much more distinctly brown in color. The sporangia are also broader in the present species, reaching 1 mm.

Rare. Maine, New York, Massachusetts, Pennsylvania. Reported common in Europe, Ceylon, Japan, etc.

32. Physarum discoidale *Macbr. n. s.*

Plate XX., Figs. 3 and 3 *a.*

Sporangia gregarious, scattered, discoidal, depressed or umbilicate above, sometimes almost annulate, snow-white, small, .5-.7 mm., stipitate; stipe about twice the sporangium, pale yellow, strand-like,

but erect, even; hypothallus none; columella none; capillitium strongly calcareous, almost as in *Badhamia,* aggregate at the center, and forming a pseudo-columella at the base of the peridium; peridial wall firm, covered with innate patches of lime, somewhat yellow at the base; spores minutely spinulose, violaceous, 7-9 μ.

This little species reaches us from California. It appears in late winter in undisturbed grass tufts and the sporangia are scattered over the lower leaves. It displays a remarkable amount of lime. The nodules, however, are not large; they are rounded and connected here and there by the ordinary retal tubules characteristic of a physarum.

33. Physarum leucophæum *Fr.*

1818. *Physarum leucophaeum* Fr., *Symb. Gast.,* p. 24.
1875. *Physarum leucophaeum* Fr., Rost., *Mon.,* p. 113, Figs. 77, 78.
1899. *Physarum leucophaeum* Fr. Macbr., *N. A. S.,* p. 21.
1911. *Physarum nutans* Pers., subspecies *leucophaeum* (Fr.) Lister, *Mycet., 2nd ed.,* p. 67.

Sporangia scattered or gregarious, stipitate; the peridium globose or sub-depressed, plano-convex, but never umbilicate below, erect, bluish-ashen; the stipe short, rugose, sub-sulcate, fuscous, brown, or sometimes almost white, even or slightly attenuate upward from a thickened base or sometimes from an indistinct hypothallus; capillitium dense, intricate; the nodules white, with comparatively little lime, thin, expanded, angular or branching; columella none; sporemass black, spores violaceous, minutely roughened, about 8-10 μ.

This extremely delicate and beautiful form is certainly not to be referred to *Tilmadoche alba* (Bull.) Fr. Fries, who seems to have known of *P. compressum* A. & S. and refers *it* to *P. nutans* Pers., *op. cit.,* p. 130, annotates the present species: "Species especially remarkable in the stipe, in the internal structure, and in its whole habit, nor is there any other with which it may be compared. . Peridium thin, not uniform, presently breaking up into laciniate scales; at first yellow, then bluish-ashen; when empty, white. The form inconstant, globose, depressed, but never umbilicate at the base." If we may judge by what Fries says on the subject, he certainly distinguished clearly between this species and *T. alba* (Bull.), to say

nothing of the stouter, larger, in every way coarser forms called by Rostafinski *P. nefroideum, P. compressum, P. lividum*, etc.

The shadowy little species has had an eventful history, dipping in and out of our story in most uncertain fashion. Beginning with Fries, as noted, it received confirmation at the hands of DeBary, and by Rostafinski was given priority over a long list of synonyms, and figured. The earlier English authors follow Rostafinski, but for Lister in the *Mycetozoa,* p. 51, the species becomes a synonym of *T. alba* as *P. nutans,* the description appropriately enlarged to receive it. Meantime American students generally confused it with the tilmadoches on the one hand and *P. nefroideum* R. (supposed) on the other. In 1897, Robt. Fries in *Sver. Myxom. Flora,* brings the species again to view as co-partner with *P. nutans* and in the *Mycetozoa, 2nd ed.,* p. 67, it appears as sub-species to the same.

The resemblance to *P. album* or *P. nutans,* is chiefly as intimated, a matter of definition; real differences are found in the irregular capillitium, fitting a globose sporange, in the character of the stipe and the consequent pose. See under *P. nutans* and *P. notabile.*

34. Physarum nodulosum *Cke. & Balf.*

1881. *Physarum nodulosum* Cke. & Balf., *Rav. N. A. F.,* Exsic., 479.
1889. *Badhamia nodulosa* Massee, *Jour. Myc.,* Vol. V., p. 186.
1891. *Physarum calidris* Lister, *Jour. Bot.,* Vol. XXIX., p. 258.
1896. *Craterium nodulosum* (Cke. & Balf.) Morg., *Jour. Cin. Soc.,* p. 87.
1899. *Physarum nodulosum* Cke. & Balf., Macbr., *N. A. S.,* p. 51.
1911. *Physarum pusillum* List., *Mycetozoa, 2nd ed.,* p. 64.

Sporangia gregarious; minute, globose, bluish-white, the sporangial wall thin and more or less encrusted with lime, breaking up irregularly, stipitate; stipe slender, longer than the sporangium, attenuate upward or even, bright brown, rugose, expanded above into a shallow cup-like base for the sporangium; columella none; capillitium with lime-knots more or less abundant, white, often uniting, badhamioid; spore-mass black; spores by transmitted light, pale lilac-brown, almost smooth, 10-12 μ.

Pennsylvania, Ohio, Iowa; Canada.

One of the smallest species of the genus, by its proportionally long stipe and small round sporangium reminding one somewhat of *P.*

globuliferum; much smaller, however, and in every way different. The generic characters are mixed, and the species has been accordingly variously referred. The lower part of the peridium is sometimes persistent after the dehiscence, and so far reminds of *Craterium.* But this character is not constant, and even at best the persisting part is very small, not greater than in *P. melleum,* for example. On the other hand, the capillitium in some sporangia is strongly calcareous, reminds of *Badhamia,* but in most sporangia the *Physarum* characters are sufficiently clear.

In the Kew Herbarium, it is said, are two American specimens under one label, *"Didymium pusillum."* One specimen is a didymium indeed, but, as it appears, *D. proximum* Berk., already described. The other is a physarum. It is proposed in *Mycetozoa, 2nd ed.,* to use the combination thus set free, as if applied by the original author to the second specimen, *not* didymium, and to make the new combination date from 1873 and so take precedence of the binomial applied in 1881 by Cooke and Balfour here retained by the law of priority.

35. Physarum maculatum Macbr.

Plate XIV., Figs. *6, 6 a, 6 b.*

1893. *Bull. Lab. Nat. Hist. Iowa,* II., p. 383.
1899. *Physarum maculatum* Macbr., *N. A. S.,* p. 47.
1911. *Physarum tenerum* Rex., Lister, *Mycetozoa,* p. 52, in part.

Sporangia scattered or gregarious, very small, .3-.4 mm., dull gray, thin-walled, dotted with minute, white calcareous granules, stipitate; stipe long, about 2 mm., stout, attenuated upward, striate longitudinally or wrinkled, filled with irregular yellow masses of lime and accordingly bright yellow in color; columella none; capillitium forming a dense net, with comparatively small yellow nodular thickenings; spores globose, purplish, each minutely papillose and displaying several scattered spots occasioned by local development of the papillae; diameter of the spores 9–10 μ.

This species was set up for the reception of certain material collected by Professor Shimek, in 1892, in Nicaragua. It remains so far unique. The small globose sporangium mounted upon a long upwardly tapering stipe, .5 mm. thick below, but narrowed at the ex-

treme base where it is lightly attached, a stem which is simply a sack stuffed with yellow lime-granules; —this and the yellow capillitium are distinguishing features. The capillitium and spores suggest *Tilmadoche viride,* but the entire habit precludes such reference. Perhaps nearest to *P. melleum.*

Castillo, Nicaragua.

Miss Lister thinks this the same as *P. tenerum* Rex. But the whole habit and external appearance are different; the stipe notably long, clumsy, surcharged with lime; a very singular form.

36. Physarum didermoides (*Pers.*) *Rost.*

Plate IX., Figs. 1, 1 *a*, 1 *b*, 1 *c*.

1801. *Spumaria (?) didermoides* Acharius, Pers., *Syn. Fung.*, p. xxix.
1829. *Diderma oblongum* Fr., *Syst. Myc.*, III., p. 103.
1831. *Spumaria licheniformis* Schw., *N. A. F.*, p. 261, No. 2364.
1832. *Physarum atrum* Schw., *Syn. Fung., Am. Bor.*, p. 258.
1875. *Physarum lividum,* Schw., Rostafinski, *Mon.*, p. 96.
1875. *Physarum didermoides* (Ach.) Rost., *Mon.*, p. 97.

Plasmodium pale, watery-white or gray; sporangia crowded, ovoid or cylindric, stipitate or sessile, blue-gray, often capped with white; stipe variable in length and structure, where well developed pure white, often flattened, expanded and diaphanous, connate with others through the irregular reticulate or sheet-like hyphothallus; columella none; capillitium ample, the lime knots angular or rounded, white connected by hyaline threads; spores in mass black, by transmitted light dark violet, decidedly spinulose, 12–15 μ.

A very variable species in many particulars. The sporangia in the same cluster are stipitate and sessile, ovoid and spherical. Our description does not quite agree with that of Rostafinski. As may be seen from the plate, it is the *outer* peridium that is with us white, burdened with lime, the inner is simpler and comparatively thin. The whiteness of the outer peridium is however, easily displaced. The colony may not show it at all, in which case the peridia remaining give to the fructification entire a pale lead color, very characteristic. The disposition of the lime in the capillitium is also notably variable. Specimens occur which in so far realize Rostafinski's *Crateriachea;* that is, the lime is massed as a snow-white pseudo-columella

in the centre of each sporangium. In such cases the lime of the outer peridium is scant or limited in amount, never forming the calcareous cap shown in Fig. 1. The size of the spores is also variable. Rostafinski gives 12.5-14.2 μ; not infrequently a single spore reaches 16 μ, a very unusual range of variation.

The species is not common in the upper Mississippi valley, but can be obtained in quantity where once it appears, as the plasmodia are profuse.

Ohio, Carolinas, Tennessee, Iowa, South Dakota, Kansas. Especially to be looked for on the bark of fallen stems of *Populus* and *Negundo*.

Brazil, India, Japan.

Physarum lividum Rost., *Mon.*, p. 95, is but a less calcareous form of this, as is evident even by the author's description. Professor Morgan thought *P. lividum* a phase of *P. griseum* Lk. Link, however, reckons *P. griseum* the same as *P. cinereum*. Link, *Diss.*, I., p. 27.

PHYSARUM LEUCOPUS *Link*.

PLATE IX., Figs. 7, 7 *a*, 7 *b*.

1809. ***Physarum leucopus*** Link, ***Diss.***, I, p. 27.

Sporangia gregarious, stipitate, globose snow-white, with a didymium like covering of calcareous particles; stipe white, not long, conical or tapering rapidly upward, slightly sulcate, brittle, from an evanescent hypothallus; columella none or small; capillitium, consisting of rather long hyaline threads, connecting the usual calcareous nodes, which are large, angular, snow-white; spore-mass black; spores by transmitted light, violet-brown, distinctly warted, about 10 μ.

The snow-white, nearly smooth stem, the small sporangium (½ mm.) covered with loose calcareous granules, distinguish this rare species. It looks like a small *Didymium squamulosum*. Fries called it *D. leucopus, Syst. Myc.*, III., p. 121.

Rare. Iowa, Ohio Maine; Portugal.

38. PHYSARUM COMPRESSUM *Alb. & Schw.*

PLATE XVIII., Fig. 14, and PLATE XIX., Fig. 12 and Fig. 4.

1805. *Physarum compressum* Alb. & Schw., *Fung. Lus.*, p. 97.
1875. *Physarum nefroideum* Rost., *Mon.*, p. 93, in part.
1875. *Physarum affine* Rost., *Mon.*, p. 94.
1909. *Physarum compressum* Alb. & Schw., Torrend, *Fl. des Myx.*, p. 197.
1911. *Physarum compressum* List., *Mycetozoa, 2nd ed.*, p. 70.

Sporangia more or less scattered, *compressed*-globose, or compressed-reniform, i. e. often umbilicate, stipitate, sessile, or elongate as if plasmodiocarpous, calcareous, white or ashen; peridium thin, covered with squamules, opening irregularly, usually by apical cleft; stipe, when present, short, stout, more or less sulcate, dark brown or ashen; capillitium a rather loose net, the nodules white, variable in size and shape; spores purplish-brown, delicately roughened, about 10–12.5 μ.

P. affine R. was in this connection set up for European types compressed indeed, but more strongly *reniform*. The author says in his further description that the form *affine* is less definitely umbilicate, has white stems, etc.; allantoid, one would now say. Such forms now begin to appear in America; and if for these a specific name is needed, it is provided, *P. affie* Rost., Plate XIX., Fig. 4.

This seems to be a cosmopolitan species, now that we have found it. However, in North America it is rare. It is reported from Pennsylvania, from Colorado; Harkness found it in California, and the writer has often collected it in Oregon, on Mt. Rainier, Washington, and in California. Europe.

39. PHYSARUM NOTABILE *nom. nov.*

PLATE IX., Figs. 2, 2 *a*, 2 *b*; PLATE XV., Fig. 2; and Frontispiece.

1873. *Didymium connatum* Peck, *Rep. N. Y. Mus.*, XXVI., p. 74.
1879. *Physarum polymorphum* (Mont.) Rost., Peck, *Rep. N. Y. Mus.*, XXXI., p. 55.
1893. *Physarum leucophaeum* Fr., Ellis, *N. A. F.*, No. 2396, *second exhibit.*
1893. *Physarum leucophaeum* Fries, Macbr., *Bull. Lab. Nat. Hist. Iowa*, II., p. 156.
1894. *Physarum compressum* Alb. & Schw., List., *Mycetozoa*, p. 53, in part.
1896. *Physarum connexum* Link., Morg., *Jour. Cin. Soc.*, p. 92, in part.
1896. *Physarum confluens* Pers., Morg., *l. c.*, p. 94.
1899. *Physarum nefroideum* Rost., Macbr., *N. A. S.*, p. 41, in part.
1911. *Physarum connatum* Lister, *Mycetozoa, 2nd ed.*, p. 71.

Sporangia gregarious, sessile, stipitate, or even plasmodiocarpous; when stipitate, depressed, varying at times to irregular reniform in the same colony; globose, the peridium strongly calcareous, cinereous-white; stipe variable, generally tapering upward, always distinctly deeply plicate-furrowed throughout, in color dark, opaque, sometimes touched with white or gray; capillitium abundant, the white lime-knots, varying in size and shape, connected by rather long hyaline threads, with here and there an empty node; spore-mass black, by transmitted light, dark, sooty brown, minutely papillose, 10–11.5 μ.

This remarkable species, while not at all difficult of recognition to one familiar with its phases, is withal very difficult to define. Normally stipitate, it often shows from the same plasmodium all sorts of forms, the shape of the fructification dependent apparently upon external conditions prevalent at the time. The amount of calcium also varies, especially in the capillitium, where there is usually much, with a tendency to the formation of something like a pseudo-columella; the outer net in such cases nearly destitute. The calcium in the stipe also varies; the black or brown stipes are, of course, free from it; the gray or white, calcareous.

In this large and difficult genus, since spore-color is receiving increased consideration, — see No. 31 preceding, — it is proper to note that in the present case two types appear, one with spore-color under the lens, as described, the other with spores violaceous with no trace of black; unshadowed.

The preceding description is based on material assembled during forty years. The form is easily discoverable by any collector throughout the entire valley of the Mississippi and eastward to Nova Scotia. For its naming, students in America have vainly waited the decision of those having access to mycologic types in Europe. It seems now certain that the species is extremely rare in the old world if there occurrent; never seen by any of the earlier taxonomists including Fries and Rostafinskĭ; perhaps adventitious in these later years, although thus far no specimen from Europe has reached this table.[1] *P. nefroideum* of Strasburg herbarium turns out, after all, *teste* Lister, to be *P. compressum* Alb. & Schw., which accordingly shall now enjoy

[1] See also, after all our trouble, *Jour. Bot.*, LVII., p. 106.

state and station of its own; our concern in European nomenclature, in the present instance, almost disappears, and we return to our synonymy from this side of the sea.

Mr. Lister would recur to Dr. Peck's *Didymium connatum,* which indeed represents the present species. In such disposition, how gladly would all concur, were the thing possible! But *Physarum connatum* is already a synonym twice over.[1] Unless we are done with the rules entirely, *P. connatum* cannot stand. *P. polymorphum* and *P. leucophaeum* are names already in use, of course; and so under the circumstances, much as it is to be regretted, there would seem nothing left to do but to cancel all past synonymy and impose a new name whose permanence may at least be hoped for, if not expected.

40. Physarum tropicale *Macbr.*

1899. ***Physarum tropicale*** Macbr., *N. A. S.,* p. 45.

Plate XV., Figs. 4, 4 *a,* 4 *b.*

Sporangia scattered, gregarious, turbinate, short stipitate, blue-gray, about 1 mm. in diameter; peridium above iridescent, green, blue, etc., dotted with minute flecks of white, below lime-less, purple or bronze shading to the brown of the stipe; stipe short, stout, slightly rugose, cylindric, non-calcareous, brown; columella none; hypothallus none; capillitium abundant, the nodes generally calcareous, small, uniform, angular, white, uniformly distributed; spore-mass, black; spores dark violet-brown, distinctly and closely warted, 12-15 μ.

A large handsome species recognizable by the peculiar turbinate sporangium, with its iridescent peridial wall in which green strongly predominates above, bronze below. The distinction between the upper and lower peridium would suggest *Craterium,* but the internal structure is not at all *Craterium*-like. The capillitium is typically of *Physarum.* The color suggests *P. leucophaeum violascens* Rost. From this species it is at once distinguished by its much longer sporangia, larger and rougher spores.

Mexico; *C. L. Smith*: Sure to be again collected once that unhappy country shall again open its forests to research.

[1] See Fries, *Syst. Myc.,* Vol. III., pp. 130, 137, Rost., *Mon.,* p. 127, and *Rep. N. Y. State Mus.,* XXXI., p. 55.

41. Physarum nicaraguense *Macbr.*

Plate XV., Figs. 7, 7 *a*, 7 *b*; XVII., 11 and 11 *a*.

1893. *Physarum nicaraguense* Macbr., *Bull. Lab. Nat. Hist. Iowa*, II., p. 383.
1894. *Physarum compressum* Alb. & Schw., List., *Mycetozoa*, p. 53, in part.
1910. *Physarum nicaraguense* Macbr., Petch, *Mycetozoa Ceylon*, p. 334.
1911. *Physarum reniforme* List., *Mycetozoa, 2nd ed.*, p. 72, in part.

Sporangia multilobate or compound-contorted, below obconic, gray, ribbed with calcareous thickenings; stem short, fuscous, longitudinally wrinkled; hypothallus distinct, black; columella none, although the lime massed at the centre of each sporangium simulates one; capillitium white, densely calcareous, with heavy angular nodules connected with comparatively short threads; spores violet, globose, spinulose, about 12 μ in diameter.

Ometepe, Nicaragua. *Professor B. Shimek.*

This species resembles in some particulars No. 39, especially in the amount of lime present in both capillitium and peridium, in the fluted, sooty stipe, and the rough spores. Mr. Lister once regarded it as the same. Nevertheless, it differs from *P. notabile* in many definite particulars. In the first place, the sporangia are different in form and habit. They are obconic, nearly always compound, convolute, or botryoid, in this respect somewhat resembling *P. polycephalum*. Besides, the sporangia are uniformly much smaller, and show constantly the strongly calcified centre, much transcending anything seen in *P. notabile*. The stipe also is peculiar, quite short, an upward extension or sweep of the common hypothallus which is usually very distinct or prominent; and, while the stipe is longitudinally wrinkled, it is much less so than in the related species, and in a different way. The spores are about the same in size, but differ in color, in this respect agreeing rather with *P. leucophaeum*.

In the *Mycetozoa, 2nd ed., l. c.*, the present species is entered as a synonym of two described by Massee: *Tilmadoche reniformis* Mass., *Mon.*, p. 336, and *Didymium echinosporum* Mass., *Mon.* 239. But Massee's description of his tilmadoche is, naturally enough, at variance in every important point with the facts in the species before us. Massee says: ". . . . sporangia deeply umbilicate *below*, sausage-shaped and curved; the stem elongated slender erect, pale brown;

capillitial nodes scattered, fusiform, colorless or yellow; spores 16–17 μ. It is evident that whatever Massee may have had in hand as he wrote it was *not P. nicaraguense,* which has spores 10–12 and reverses the remaining description.

But *Didymium echinosporum* also defines *T. reniformis* since Lister, *Mon.,* p. 54, says they are based on two gatherings of one species. Of this second species Massee says: "A superficial resemblance to *T. nutans,* but distinct in the capillitium which contains *no trace of lime;* spores 12–14 μ!" Again it is evident that whatever Massee had in hand when he wrote, it was *not P. nicaraguense* which "has capillitium almost Badhamia-like," i. e., burdened with lime!

Worse than all; Mr. Massee's *alleged* types are in evidence; one labelled *P. reniforme*[1] includes forms of *P. didermoides* and of *P. nicaraguense;* the other labelled by Berkeley *P. nutans* is *P. nicaraguense.* So Mr. T. Petch, *Mycet. Ceyl.,* who enters our species as from Ceylon, and the names cited from Berkeley, Massee, and others, as synonyms. He remarks, "Probably Thwaites' 135 and 55 were mixed during examination"! Doubtless! and some other things too! What Massee did have beneath his lens, no one now may say but apparently not in either case cited, the physarum of Central America.

42. Physarum sulphureum *Alb. & Schw.*

1805. *Physarum sulphureum* Alb. & Schw., *Consp. Fung.,* p. 93, Tab. VI, f. 1.
1818. *Physarum flavum* Fries, *Symb. Gast.,* p. 22.
1875. *Physarum sulphureum* Alb. & Schw., Rost., *Mon.,* p. 101.[2]

Sporangia gregarious, sub-globose, rugulose-squamulose, .6–.8 mm., sulphur-yellow, stipitate; peridium membranous, covered with calcareous scales; stipe stout, white, charged with lime, furrowed; columella none; capillitium strongly calcareous, the nodules large, white; spores violaceous, rough, 9–11 μ.

Northern Europe. (Lusatia) Lausitz, Alb. & Schw.; dim old

[1] It would seem that M. Massee would have written *T. reniformis,* were this authentic.

[2] For further synonymy, see under *P. auriscalpium,* No. 49.

Wendish region on the south borders of Brandenburg. Reported also from Sweden.

The description and figure given by Schweinitz, 1805, *l. c.*, leave no doubt as to what he had in hand. Twenty or thirty years later, having spent the interval in this country,—bishop, indeed, of the Moravian churches, but a student of fungi all the while,—he reports the same thing from this country; *Proc. Phil. Acad. Sci.*, 1834. Cooke also lists it in *Myxomycetes of the U. S.* It surely will be found again. Mr. Lister thinks *P. variable* Rex may be the same thing.

43. Physarum carneum *G. Lister and Sturgis.*

1910. *Physarum carneum* G. Lister and Sturgis, *Jour. Bot.*, Vol. XLVIII, p. 63.

Sporangia gregarious, stipitate, subglobose, .5 mm. in diameter, ochraceous-yellow above, flesh-colored below; peridium membranous, pale yellow, lime-granules evenly distributed; stipe short, translucent, pinkish flesh-colored; capillitium dense, nodules white; spores purplish-brown, spinulose, 8 μ.

Differs from *P. citrinellum* in the membranous peridium, flesh-colored stalks and smaller spores.

Colorado; *Dr. W. C. Sturgis.*

44. Physarum citrinellum *Peck.*

1831. *Physarum caespitosum* Schw., *Syn. N. A. F.*, No. 2301(?).
1869. *Diderma citrinum* Peck, *Rep. N. Y. Mus.*, XXII., p. 89.
1870. *Physarum citrinellum* Peck, *Rep. N. Y. Mus.*, XXXI., p. 55.
1894. *Craterium citrinellum* List., *Mycetozoa*, p. 74.
1899. *Physarum caespitosum* Schw., Macbr., *N. A. S.*, p. 37.
1911. *Physarum citrinellum* Peck, List., *Mycetozoa, 2nd ed.*, p. 62.

Sporangia gregarious, or scattered globose, short-stipitate, pale yellow or ochraceous, smooth or slightly roughened by the presence of minute lime-particles; peridium more or less distinctly double, the outer calcareous, fragile, the inner very delicate, with here and there a calcareous thickening, ruptured irregularly; stipe very short, half the sporangium, fuliginous, furrowed, expanded below into an im-

perfectly defined hypothallus; capillitium abundant, the nodes stellate-angular, large, the internodes delicate, short; spore-mass black, spores violaceous-brown by transmitted light, strongly spinulose, 10–12.5 μ.

A very distinct and handsome species. Easily recognizable at sight by its large, globose, almost sessile and yet distinctly stalked sporangia. The color to the naked eye is pale ochraceous or buff. Only under a moderate magnification do the citrine tints come out.

In the *Twenty-second N. Y. Report,* Dr. Peck incorrectly referred this species to *Physarum citrinum* Schum. On the appearance of Rostafinski's *Monograph,* Dr. Peck in his revised list, *l. c.,* writes *P. citrinellum* Peck, with description on p. 57, following. Under the last name the species has been generally recognized in the United States and distributed. *N. A. F.,* 2490.

In the former edition, this species was referred to *P. caespitosum* Schw., of which the original description is as follows: "*P. caespitosum* L. v. S., pulcherrimum. In foliis et stipitibus Rhododendri, Bethlehem. Physarum substipitatum aut saltem basi attenuata, caespitosim crescens et sparsim. Caespitulis 3 linearibus; peridiis stipatis, turbinatis, ovatis, basi contracta membranula exterori luteosquamulosa aut punctato-squarrulosa. Sporidiis nigro-brunneis, floccis citrinis inspersis." *Synopsis N. A. Fungi,* 2301.

The type from the Schweinitz herbarium is no longer in evidence. Without it, the reference cannot be sustained.

Not uncommon in the eastern United States; reported also from Japan.

45. Physarum albescens *Ellis.*

Plate XVI., Figs. 4, 4 *a.*

1889. *Physarum albescens* Ellis *in litt:* not described.
1893. *Physarum auriscalpium* Cke., Macbr., *Bull. Lab. N. H. Iowa,* No. 2, p. 155, in part.
1894. *Physarum virescens* var. *nitens* List., *Mycetozoa,* p. 59, in part.
1899. *Physarum virescens* var. *nitens* List., Macbr., *N. A. S.,* p. 34, in part.
1899. *Leocarpus fulvus* Macbr., *N. A. S.,* p. 82.
1911. *Physarum fulvum* Lister, *Mycet., 2nd ed.,* p. 60.
1911. *Physarum virescens, nitens* List., *Mycet., 2nd ed.,* p. 84, in part.

Sporangia gregarious, scattered, ovoid or globose, pale yellowish or fulvous, opening irregularly above, stipitate; the peridium double, the outer layer more or less calcareous, the inner delicate, almost indistinguishable, persistent below as a shallow cup; the stipe long, weak, striate, fulvous or yellow; hypothallus distinct, venulose, or more or less continuous; capillitium pallid or white, dense, with here and there below large continuous yellow calcareous nodules; columella none; spore-mass black; spores by transmitted light, dark brown, rough, 13–15 μ. Varies to forms with single (inner) peridium and simple physaroid capillitium. *Vid.* descriptions cited for *P. auriscalpium, P. nitens,* etc.

This interesting form is from our western mountains, and suggests at first a diderma; but the capillitium is entirely unlike that of a diderma in color and structure, and plainly belongs here. Plasmodium yellow, on fallen leaves and twigs. Our material is from Prof. Bethel, Denver; and Lake Tahoe, Nevada; later from Dr. Weir, Montana. No doubt common at high altitudes near the snow-line in mountainous regions, probably around the world.

As indicated above, this was originally entered as of the genus *Leocarpus;* the taxonomic history of the form may interest readers who note with surprise the presentation in synonymy here developed.

About thirty-five or forty years ago Dr. Harkness of California sent to Mr. Ellis of New Jersey a slime-mould which the sender referred to *Diderma albescens* Phillips, (*Grev.* V., p. 114, 1877). Ellis sent a small bit to the Iowa herbarium without other comment, save that he thought it a physarum. Sometime later Mr. Ellis received from Father Langlois, a correspondent in Louisiana, specimens he esteemed the same thing. He expressed the opinion that if this were what Phillips had found in California, it should perhaps be called a physarum. The Louisiana material by his courtesy came also to this table. The material was scanty, in poor condition, and all waited further light. To these specimens the writer paid less attention. They were in the hands of his correspondents and the courtesy of the case required their further consideration by Dr. Rex.

In 1889 Mr. Holway found in Iowa, a physarum of which he sent part to Ellis and the remainder to the writer who, then engaged on the *Myxomycetes of East. Iowa,* referred his part of this Iowa gath-

ering to the *Physarum auriscalpium* Cke. as found in New York. Under this caption a specimen was later sent to Mr. Lister, who has, as we see, consistently regarded the thing as a variety of *P. virescens* Ditmar, *P. nitens* List.

Meantime in 1898 Colorado material from Professor Bethel reached the University. This did not recall any of the materials sent from Ellis. *Diderma albescens* had meanwhile come again from California, and been recognized as *Diderma niveum* Rost.

Accordingly, in *N. A. S.* the latest arrival from Colorado was described as a new species, and with some temerity perhaps, offered as a second species of the hitherto monotypic *Leocarpus,* all on account of the peculiar capillitium. Sometime after publication our most valued correspondent Mr. Bilgram called attention to the resemblance between the Colorado and Louisiana material already referred to. The University specimens as stated were small, broken, and in every way poor, but enough remained to indicate the evident justice of our correspondent's suspicion. Further investigation of the Holway material in Philadelphia showed that *it too was entitled to consideration!* Inasmuch as the Holway sending was all from one plasmodium, all difficulties vanished at once. The Iowa gathering showed two phases: one at the University represents *P. nitens,* physaroid, single-walled; while the Philadelphia part of the gathering corresponds, poorly it is true, but in fact, as *now* appears, to the form coming in perfection from Colorado; leocarpine in structure, published as *Leocarpus fulvus; P. fulvum* Lister. Since the combination *P. fulvum* is already in use, synonym of *P. rubiginosum,* it seems better to write the name suggested by Ellis; *Physarum albescens* never having been published, because *Diderma albescens,* as noted took care of itself.

Since Rostafinski we separate all these physaroid forms chiefly by capillitial characters: capillitial structure separates genera. *Physarum diderma* is a physarum despite its double wall. And so here *Leocarpus* was set out by its differentiating capillitium. In good specimens of the present species a large part of the capillitial net is entirely free from lime, so that when the peridium first opens at the summit, sometimes no trace of lime appears; the calcareous deposits are below, and tend to occupy not the nodal intersections as in

Physarum, but in large masses involve portions of the net itself, nodes and all, as in *Leocarpus.* Miss Lister's beautiful figures, *op. cit.,* Figs. 66 and 82, show this very well.

In *The Journal of Botany,* 52, p. 100, the distinguished author and artist records the discovery of this species in the mountains of Switzerland. She says: "This specimen shows a striking resemblance to *Leocarpus fragilis* Rost., both in the shape of the sporangia and in the capillitium and spores; but although the color of the sporangia varies in both these species, the walls of *P. (L.) fulvum* are membranous and rugose with included deposits of lime granules and show nothing of the polished cartilaginous layers characteristic of *L. fragilis.*"

The species is a boundary type at best, and shows again how artificial all our taxonomy is apt to prove, when the number of presentations of some particular type becomes larger.

For these reasons, the present author writes *Physarum,* and believes the question of identity in a perplexing case fortunately settled.

46. Physarum variabile *Rex.*

1893. *Physarum variabile* Rex, *Proc. Phil. Acad.,* p. 371.
1911. *Physarum variabile* Rex, List., *Mycetozoa, 2nd ed.,* p. 47.

Sporangia scattered, stipitate, sub-stipitate or sessile, about 1 mm. high; regularly or irregularly globose, ellipsoidal, obovate or cylindric-clavate in shape; sporangium wall sometimes apparently thick, of a dingy yellow or brownish-ochre color, slightly rugulose on the surface, crustaceous, brittle, rupturing irregularly, sometimes thin, translucent, covered externally with flat circular calcic-masses falling away in patches; stipes nearly equal, occasionally much expanded at the base, rough, longitudinally rugose, variable in size, sometimes one-third of a millimetre high, sometimes a mere plasmodic thickening of the base of the sporangium; color of stipes varying from a yellowish-white to a dull brownish-gray; capillitium a small-meshed network of delicate colorless tubules with large, many-angled, rounded masses of white, or rarely yellowish-white lime-granules at the nodes; no true columella, but often a central irregular mass of white lime-granules; spores dark violet-brown, verruculose, 9–10 μ.

Pennsylvania. *Dr. Rex.*

Lister, *op. cit.*, describes a variety, *sessile,* presenting plasmodiocarpous fructification, from Ceylon, also from Antigua, but there are some doubts as to the identity of these with American sessile and plasmodiocarpous forms. Vid. *Jour. Bot.* XXXVI., p. 113.

47. Physarum auriscalpium *Cooke.*

1877. *Physarum auriscalpium* Cooke, *Myx. U. S.,* Am. Lyc. Nat. Hist. N. Y., XI., p. 384.
1877. *Physarum auriscalpium* Cke., *Myx. Gr. Brit.,* Pl. 24, f. 253-4.
1893. *Physarum sulphureum* (Alb. & Schw.), Sturgis, *Bot. Gaz.,* XVIII., p. 197.
1898. *Physarum auriscalpium* Cke., List., *Jour. Bot.,* XXXVI., p. 115.
1911. *Physarum auriscalpium* Cke., List., *Mycetozoa, 2nd ed.,* Syn. excl.

Sporangia scattered, stipitate or occasionally sub-sessile spherical, .8–1 mm. high; peridium granulated, bright golden yellow; stipe, when present, one-half to two-thirds the height of the sporangium, blackish-brown; hypothallus, minute, thin, brown; columella absent; capillitium rather dense, composed of large angular nodes, completely filled with bright yellow granules of lime, and connected by very short, delicate, colorless inter-nodes destitute of lime; spores globose minutely verruculose, or asperate, 10.7–11.8 μ in diameter, brownish-violet by transmitted light, black in the mass.

This is the original description, 1893, of *P. sulphureum* (Alb. & Schw.) Sturgis; the author last named having compared certain stalked New England forms with what he could find of *P. sulphureum* in the herbarium of Schweinitz at Philadelphia, and having, as he thought, established identity.

Meantime Mr. Lister had been inclined to refer *P. auriscalpium* Cke. to *P. rubiginosum* Fr., *Mycetozoa,* p. 61.

In 1898 Professor Sturgis and Mr. Lister agreed that the New England specimens, owing to color and character of stipe and some other differences could not be the Schweinitzian species, but did indeed conform much better with those in London labelled *P. auriscalpium* Cke.

Accordingly *P. sulphureum* is something else, very different, (v.

A. & S., *Cons. Fung.* Tab., VI., f. 1), and by aid of recent[1] discoveries in Sweden goes its own way again. Meanwhile *P. sulphureum* Sturgis stands, a new type for *P. auriscalpium* Cke., the description modified to suit; the lamented pioneer-author receives honor due, and his handsome species, with its "golden graving," may now march, let us hope, under appropriate banner far down the fair highway to future fame!

48. Physarum oblatum *Macbr.*

Plate III., Fig. 6; Plate XIV., Figs. 3, 3 *a*, 3 *b*.

1879. *Physarum ornatum* Peck, *Rep. N. Y. Museum,* XXXI., p. 40(?).
1893. *Physarum oblatum* Macbr., *Bull. Lab. Nat. Hist. Iowa,* II., p. 384.
1896. *Craterium maydis* Morg., *Myx. Miam. Vall.,* p. 87.
1909. *Physarum maydis* Torr., *Flor. des Myxo.,* p. 193.
1911. *Physarum maydis* Torr. List., *Mycet., 2nd ed.,* p. 59.

Sporangia gregarious, stipitate, small, bright yellow, globose or depressed-globose, rough; stipe reddish-brown or fuliginous, even, short, slender; hypothallus scant, black, or none; columella none; threads of the capillitium yellow, delicate, connecting the rather dense and abundant yellow lime-granules; spore-mass brownish-black, spores violaceous, minutely but distinctly spinulose, 9–11 μ.

This species is easily recognizable by its brilliant yellow color, somewhat rugose, sometimes scaly peridium, its richly calcareous capillitium, also bright yellow where not weathered or faded, its dark brown, translucent, non-calcareous stem. In dehiscence, the base of the peridium in cup-form, sometimes persists. This circumstance, with the fact that decaying maize-stalks and leaves are a favorite habitat, led Professor Morgan to its description as *Craterium maydis*. But it is doubtless a physarum, occurring on habitats of all sorts, from Ohio to Iowa, Colorado and Washington. Ceylon(?).

Physarum ornatum Peck is doubtfully cited here, although Professor Morgan thought it the same as *P. oblatum*. As a matter of fact the original brief description, *op. cit.*, does not suggest either *P. oblatum* or *P. maydis;* rather a form of *Tilmadoche viridis*. Professor

[1] Robt. E. Fries, *Ofvers. K. Vetens. Akad. Forh.,* 1899, No. 3, p. 225.

Sturgis, *Notes on Some Type Specimens of Myxo., in the N. Y. Museum, Trans. Conn. Acad. Arts and Sci.*, Vol. X., Pt. 2, p. 470, says that of the type almost nothing remains, that the name *P. ornatum* Pk. "should be discarded."

49. Physarum galbeum *Wing.*

1890. *Physarum galbeum* Wing., Ell., *N. A. F.*, 2491 (no description).
1892. *Physarum petersii* Berk. & C., Mass., *Mon.*, p. 296, in part.
1894. *Physarum berkeleyi* Rost., List., *Mycetozoa*, p. 48, in part.
1899. *Physarum galbeum* Wing., Macbr., *N. A. S.*, p. 53.
1911. *Physarum galbeum* Wing., List., *Mycetozoa, 2nd ed.*, p. 59.

Sporangia scattered, globose, stipitate, often nodding, golden yellow, the peridium exceedingly thin, breaking up into patches on which the yellow lime granules are conspicuous; stipe non-calcareous, pale brown or amber-colored, longitudinally wrinkled, about one and one-half times the diameter of the peridium; columella none; hypothallus none; capillitium dense, extremely delicate, the nodes only here and there calcareous, the lime knots when present small, angular, yellow; spore-mass pale brown; spores almost smooth, lilac- or violet-tinted, 7.5–10 μ.

Distinguished among the small delicate species with which it will be naturally associated, by the yellow, richly calcareous wall of the globose sporangium and the almost limeless capillitium. The stipe is hollow and contains irregular masses of refuse granular matter, but no lime so far as we have been able to discover. *P. flavicomum*, to which the species is related most closely, differs in having the wall non-calcareous, iridescent, as well as in the color throughout; the character of the capillitium, in which lime is abundant; the absence of refuse-matter in the stem.

Pennsylvania, Iowa, Minnesota.

50. Physarum tenerum *Rex.*

1890. *Physarum tenerum* Rex., *Proc. Phil. Acad.*, p. 192.
1894. *Physarum polymorphum* Rost. var. *obrusseum*, Lister, *Mycet.*, p. 48.
1899. *Physarum obrusseum* (Berk. & C.) Rost., Macbr., *N. A. S.*, p. 52.
1911. *Physarum tenerum* Rex, List., *Mycetozoa, 2nd ed.*, p. 52.

The peridium thin, membranaceous, thickly studded with circular, flattened, yellow granules of lime; stipe long, slender, subulate, opaque, pale brown, striate and black below, pale yellow above; columella none; capillitium yellow or white, delicate, forming a loosely but regularly meshed network with numerous small round or rounded granules at the intersections; spores dark brown, delicately warted, 7–8 μ.

This delicate physarum, very fragile and evanescent, seems to be distinct, by reason of its characteristic rounded lime granules, from any similar, stipitate species. It varies a little according to locality. Ohio specimens are a little larger and have thicker and more calcareous stipes than is usual in those from Philadelphia. The walls of the sporangia when fully matured generally break into several petal-like segments which finally become reflexed. The description given by Berkeley is entirely insufficient.

In an earlier edition this species was entered as *P. obrusseum* following the Polish text. Miss Lister who has the type of *Didymium obrusseum* at hand considers it as representing a phase of *Physarum polycephalum* Schw. *D. tenerrimum* Berk. & Curt. is judged the same. *P. tenerum* Rex is, in any event, certain, and the combination is adopted.

Rare: — Pennsylvania, Ohio, Louisiana, Texas, Iowa, Portugal, Japan.

51. Physarum flavicomum *Berk.*

Plate XV., Figs. 3, 3 *a*.

1845. *Physarum flavicomum* Berk., *Hook. Jour. Bot.,* IV., p. 66.
1873. *Physarum cupripes,* Berk. & Rav., *Grev.,* II., p. 65.
1875. *Physarum berkeleyi* Rost., *Mon.,* p. 105.
1894. *Physarum berkeleyi* Rost., List., *Mycetozoa,* p. 57.
1899. *Physarum flavicomum* Berk., Macbr., *N. A. S.,* p. 53.
1911. *Physarum flavicomum* Berk., List., *Mycetozoa, 2nd ed.,* p. 58.

Sporangia gregarious, small, spherical, at first fuliginous throughout, stipitate; the peridium thin, destitute of lime, iridescent, breaking up and deciduous in patches, except at the base; stipe twice the diameter of the peridium, brown, fluted, not hollow, tapering upward from a small but distinct, radiant hypothallus; columella none;

capillitium dense, persistent, the nodes frequently calcareous, elongate and vertical, especially below, yellow; spore-mass brown; spores by transmitted light, bright violaceous-brown, slightly papillose, 9–10 μ.

This species is instantly distinguishable from all cognate forms by its peculiar sooty color. Not less is the species structurally marked by its capillitium. The latter below is exactly as in the species of *Tilmadoche*. Indeed, the present species unites characters supposed to distinguish *Physarum* from *Tilmadoche*, and would so far justify those authors who bring all the species of both genera together under one generic name. In any case the species is by its capillitium entirely distinct from *P. galbeum*, as well as by the structure of the stipe and the peridial surface. The plasmodium, at first watery, emerges from decayed elm logs and soon takes on a peculiar greenish tint preserved somewhat in the mature fruit.

Rostafinski, *Monograph*, pp. 105, 106, rejects Berkeley's specific name, *flavicomum*, because it refers to the somewhat indefinite, characteristic color. As this is no valid reason for change, we have restored Berkeley's specific name, which by general consent has priority. *N. A. F.*, 3299.

Not common. New Jersey, Ohio, South Carolina, Iowa.

52. Physarum bethelii *(Macbr.) Lister.*

1899. *Tilmadoche bethelii*, Macbr., *Exempl. ad Herbaria.*
1911. *Physarum gyrosum* Rost., List., *Mycetozoa, 2nd ed.*, p. 75.

Sporangia scattered, globose, umbilicate below, .5–1 mm. in diameter, iridescent blue, or sometimes tinged by the presence of delicate pale yellow calcareous scales, stipitate; stipe rather short, black or dark brown, equal; capillitium dense, radiating from the black, slightly intrusive summit of the stipe, and from the base of the peridium ascending; the nodules not numerous, elongate, branching betimes, pale yellow; spores minutely roughened, 10–12 μ.

This beautiful delicately tinted little species is clearly tilmadochoid in the Friesian sense. The capillitium persists after the fall of the upper filmy peridium, adherent below to the persisting peridial base. Collected thus far twice only; by Professor Bethel and by Professor Sturgis, Colorado.

SECTION 2

Tilmadoche Fries

53. PHYSARUM GYROSUM *(Rost.) Jahn.*

1875. *Physarum gyrosum* Rost., *Mon.*, p. 111.
1902. *Physarum gyrosum* Rost., Jahn, *Ber. Deutsch. Bot. Ges.*, XX., p. 272, t. XIII.
1911. *Physarum gyrosum* Rost., List., *Mycetozoa, 2nd ed.*, p. 75.

Sporangia gyrose, variable in form, or plasmodiocarpous and irregular, venulose, sessile upon a common, strongly developed hypothallus, sometimes isolated and irregularly globose, dehiscing irregularly or by longitudinal fissure, yellowish or greyish white; columella none; capillitium delicate, the nodules elongate, variable in size; spores pale violaceous, minutely spinulose, 7–10 μ.

This is a European species recently resuscitated by Dr. Jahn. It perhaps might more correctly be recorded as *P. gyrosum* Jahn, since Rostafinski certainly attempted in his description to cover two apparently distinct things. He seems to have had before him *Fuligo muscorum* Schw. and *"P. gyrosum,"* but he thought them the same, and his description touches now one, now the other. Since *F. muscorum* Schw. has all along held its own and received due recognition, it is interesting to note the recovery of this gyrose form.

Judging by description and figures, it resembles a very large, sessile phase of *P. polycephalum*. See further under that species.

Europe, Japan, Eastern United States (?).

54. PHYSARUM POLYCEPHALUM *Schw.*

PLATE VIII., Figs. 2, 2 *a*, 2 *b*.

1822. *Physarum polycephalum* Schw., *Syn. Fung. Car.*, No. 382.
1829. *Didymium polycephalum* (Schw.) Fries, *Syst. Myc.*, III., p. 122.
1837. *Didymium polymorphum* Mont., *Ann. Sci. Nat.*, Ser. 2, 8, p. 361.
1837. *Didymium gyrocephalum* Mont., *op. cit.*, p. 362.
1875. *Physarum polymorphum* (Mont.) Rost., *Mon.*, p. 107.
1875. *Tilmadoche gyrocephala* (Mont.) Rost., *Mon.*, p. 131.
1899. *Tilmadoche polycephala* (Schw.) Macbr., *N. A. S.*, p. 57.
1911. *Physarum polycephalum* Schw., List., *Mycetozoa, 2nd ed.*, p. 58.

Sporangia spherical or irregular, impressed, gyrose-confluent, helvelloid, umbilicate below; peridium thin, ashy, covered with evanescent yellow squamules, fragile; stipe from an expanded membranaceous base, long-subulate, yellow; spores smooth, violet, 9–11 μ.

A most singular species and well defined is this, occurring in masses of decaying leaves or on rotten logs. The plasmodium at first colorless; as it emerges for fructification, white, then yellow, spreading far over all adjacent objects, not sparing the leaves and flowers of living plants; at evening slime, spreading, streaming, changing; by morning fruit, a thousand stalked sporangia with their strangely convoluted sculpture. The evening winds again bear off the sooty spores, and naught remains but twisted yellow stems crowned with a pencil of tufted silken hairs. August.

Although Rostafinski's description of this species is accurate and marks exactly a *Tilmadoche* and is very different from his description of *Physarum polymorphum,* nevertheless it is probable that both descriptions have reference to the same thing. All specimens on which both species were based were American; *P. polymorphum,* North American. But the only North American form to which reference can be made is that by Schweinitz called *P. polycephalum* and, fortunately, sufficiently described. Furthermore, Rostafinski, under *T. gyrocephala,* himself affirms the probable identity of Montagne's *Didymium gyrocephalum* with the Schweinitzian species, and uses Montagne's specific name provisionally. For these reasons it seems proper to write the species as above.

Widely distributed and common, from Maine and Canada to Nebraska, and Washington and south to Nicaragua.

This species is so common that its plasmodium and fructification may be easily observed. Professor Morton E. Peck, who has been for years a close observer of the vegetative phases of our Iowa species, says of *P. polycephalum:* "In one instance I observed a plasmodium for twelve successive days on the surface of a decaying stump. During this period it crept all around the stump and from top to bottom several times. At one time the color was bright yellow; at another, greenish yellow; and once, shortly before fruiting, it became clear bright green. A heavy rain fell upon the plasmodium but it ap-

peared to sustain little injury and ultimately developed normal sporangia."

55. Physarum nutans *Pers.*

1791. *Sphaerocarpus albus* Bull., *Champ.*, p. 137, t. 407, III., and t. 470, I, A-L.
1791. *Stemonitis alba* (Bull.), Gmel., *Syst. Nat.*, p. 1469 (?).
1795. *Physarum nutans* Pers., *Ust. Ann. Bot.*, XV., p. 6.
1803. *Trichia cernua Schum., Enum. Pl., Saell.*, II., p. 241.
1829. *Physarum cernuum* (Schum.) in part, Fr., *Syst. Myc.*, III., pp. 130, 147.
1848. *Tilmadoche cernua* (Schum.) Fr., *Summ. Veg. Sc.*, p. 454.
1873. *Tilmadoche nutans* (Pers.) Rost., *Versuch*, p. 10.
1899. *Tilmadoche alba* (Bull.) Macbr., *N. A. S.*, p. 58.
1911. *Physarum nutans* Pers., List., *Mycet., 2nd ed.*, p. 67, in part.

Sporangia gregarious, depressed-spherical, stipitate, umbilicate, gray or white, thin-walled, nodding; stipe long, tapering upward, brown or black below, ashen white above, lightly striate, graceful; capillitium abundant, threads delicate, intricately combined in loose persistent network with occasional minute, rounded, or elongate calcareous nodules; spores minutely roughened, globose, about 10 μ.

The nodding, lenticular, umbilicate sporangium, barely attached to the apiculate stipe, is sufficient to distinguish this elegant little species, recognized and quite aptly characterized by mycologists for more than one hundred years. As *Sphaerocarpus albus* Bulliard first prescribed the limits by which the species is at present bounded. The description by Fries (*Syst. Myc.*, III., 128) is especially graphic; "Peridium very thin, in form quite constantly lenticular, umbilicate at base, at first smooth then uneven, generally laciniate-dehiscent, the segments persistent at least at base."

The stipe is usually white above, fuscous below, at the apex almost evanescent; hence the cernuous sporangia. The same character is less strikingly manifest in the species next following.

The plasmodium is bright yellow, sometimes greenish. Brought in from the field and maturing under a bell-jar, the color changes to a watery white just before the sporangia rise in fruit. *P. album* Fuckel, *Rhen. Fl.*, No. 1469, 1865, is believed to be *P. cinereum* (Batsch) Pers.

Persoon changed Bulliard's specific name in this case to furnish one himself, more descriptive as he thought and distinctive. His success in this attempt must be esteemed but partial since all the related forms, immediately listed, *nod* as well. Bulliard's name as applied by Persoon is therefore to be preferred. But the transfer from *Tilmadoche* to *Physarum* loses for us one step in the ladder of priority. *P. album* (Bull.) may not enter here, since Fries has given us one species under that title. So Persoon comes next on the list, all the world now nodding approbation, let us hope!

Under the name *Physarum gracilentum,* Fries cites an extremely delicate form of this species. The sporangia are of the most minute, about .2–.3 mm. in diameter, globose, slightly umbilicate below, the stipe usually white at top, but sometimes black throughout. This graceful form occurs rarely in undisturbed woods.

Widely distributed in the eastern United States, apparently rare in the west. Reported from various parts of the world; Europe, Japan, Australia, etc.

56. PHYSARUM VIRIDE *(Bull.) Pers.*

1791. ***Sphaerocarpus viridis*** Bull., *Champ.,* t. 407, Fig. I.
1791. ***Sphaerocarpus luteus*** Bull., *Champ.,* t. 407, Fig. II.
1791. ***Sphaerocarpus aurantius*** Bull., *Champ.,* t. 484, Fig. II.
1791. ***Stemonitis viridis*** (Bull.) Gmel., *Sys. Nat.,* p. 1469.
1794. ***Physarum aureum*** Pers., Römer, *Neu. Mag. f. die Bot.,* I., p. 88.
1795. ***Physarum viride*** Pers., Usteri, *Ann. Bot.,* XV., p. 6.
1801. ***Physarum aurantium*** Pers., *Syn. Meth.,* p. 173.
1829. ***Physarum nutans*** var. Fries, *Syst. Myc.,* III., pp. 128–129.
1875. ***Tilmadoche mutabilis*** Rost., *Mon.,* p. 129.
1880. *Tilmadoche viridis* (Bull.) Sacc., *Michelia,* II., p. 263.
1894. ***Physarum viride*** Pers., List., *Mycetozoa,* p. 50.
1899. *Tilmadoche viridis* (Bull.) Sacc., Macbr., *N. A. S.,* p. 59.
1911. ***Physarum viride*** Pers., List., *Mycetozoa, 2nd ed.*

Sporangia globose, flattened or lenticular, beneath plane or concave, variously colored, yellow, greenish yellow, rusty orange, stipitate, nodding; the peridium splitting irregularly or reticulately; stipe variable in length and color, through various shades of red and yellow, subulate; capillitium strongly developed, concolorous with sporangium, the tubes with colorless or yellow calcareous thickenings; spores smooth, fuscous or violet-black, 8 μ.

A very handsome and rather common little species; like the preceding, but generally greenish-yellow in color, and occasionally brilliantly orange without a suggestion of green. Indeed, the color is so variable that some authors have been disposed to discard the species entirely, inasmuch as the chief specific character is color. The plasmodium is pale yellow, in rotten logs, stumps, etc. In the paler yellow or greenish forms the stipe is more commonly black.

This is *Physarum luteum* (Bull.) Fries, and likewise also includes the three varieties, *viride, aureum, coccineum,* listed by the same author under *P. nutans,* while he at the same time remarks that they might with equal propriety be elsewhere referred. Rostafinski considers that all the colored forms agree in capillitium sufficiently to be associated under one name and are in the same way unlike *T. nutans.*[1] Rostafinski thinks to avoid confusion by suggesting a more fitting specific name, *T. mutabilis,* but there seems no good reason for not adopting the earliest identifiable specific appellation, which in this case appears to be *viride.* The yellow phase is common in Iowa, resembles in size, color, stipe, *P. galbeum* Wingate, but is instantly distinguishable by the capillitium. *N. A. F.,* 1213.

Widely distributed specimens are before us; — from New England, New York, Pennsylvania, Maryland, Ohio, Nebraska, Iowa, California, Oregon, Canada, Nicaragua, Samoa, Alaska, India, etc.

EXTRA-LIMITAL[2]

Physarum mutabile *(Rost.) List.*

1875. *Crateriachea mutabilis* Rost., *Mon.,* p. 125.
1892. *Crateriachea mutabilis* Rost., Mass., *Mon.,* p. 344.
1894. *Physarum cinereum* List., *Mycetozoa,* p. 55, in part.
1895. *Physarum crateriachea* List., *Jour. Bot.* XXXIII., p. 323.
1910. *Physarum crateriachea* List., Petch, *Mycetozoa Ceylon,* p. 336.
1911. *Physarum mutabile* List., *Mycetozoa, 2nd ed.,* p. 53.

Sporangia cylindrical ovoid or subglobose white, plasmodiocarpous, sessile or stipitate, stipes when present yellow, with or without lime, often connected by a hypothallus; peridium thin, squamulose; capil-

[1] The Polish author wrote Tilmadoche instead of Physarum in each case cited.

[2] Forms cited are chiefly those likely to be found in our neighboring tropics, West Indies, etc.

litium persistent, intricate, the nodules white, more or less confluent at the center to form a real or a pseudo-columella; spores brownish-purple, spinulose, 7–8 μ.

Reported from Europe, Africa, Ceylon.

PHYSARUM ROSEUM *Berk. & Br.*

1873. *Physarum roseum* Berk. & Br., *Jour. Linn. Soc.,* XIV., p. 84.

Plasmodium rose-red; sporangia gregarious, stipitate, globose, rose-red; the stipe erect, brown, rugulose, translucent; capillitium lax, delicate, lilac, the nodules few, large, purple-red, branching; spores reddish-lilac or brown, minutely spinulose, 7–10 μ.

Reported from Ceylon, Java, Borneo, Japan.

PHYSARUM DICTYOSPERMUM *List.*

1905. *Physarum dictyospermum* List., *Jour. Bot.,* Vol. XLIII., p. 112.

"It is distinguished from the other known species of *Physarum* by the strongly reticulated spores. Its nearest ally is perhaps *P. psittacinum* which it resembles in having orange-red lime-knots and in the sporangium-wall being studded with orange crystalline disks." *Lister.*

Reported collected once only; New Zealand.

PHYSARUM STRAMINIPES *List.*

1898. *Physarum straminipes* List., *Jour. Bot.,* Vol. XXXVI., p. 163

Plasmodium white; sporangia greyish-white, obovoid or wedge-shaped, .7 mm. in diameter, clustered or scattered, stipitate or sessile, when stipitate stalks long, weak; peridium membranous, pale purple; capillitium a persistent rigid net, the nodules white, rounded, sometimes aggregate as a pseudo-columella; spores purple-brown, 10–11 μ, warted, the papillae in definite patches.

Related to *P. compressum.*

Reported from England; Germany.

PHYSARUM CRATERIFORME *Petch.*

Physarum crateriforme Petch, *Ann. Perad.,* IV., p. 304.
Physarum crateriforme Petch, List., *Mycetozoa, 2nd ed.,* p. 69, Pl. 76.

Sporangia gregarious, globose, clavate or crateriform, sessile or

stipitate, white; stalk when present opaque conical, black below, white above, in crateriform sporangia entering and developed as a columella; capillitium various, strongly calcareous, the nodules either grouped in a pseudo-columella, or in globose sporangia, rod-like, ascending; spores closely spinulose, 11–15 μ.

Reported from Ceylon, Japan, West Indies; Lisbon.

PHYSARUM GULIELMÆ *Penzig.*

1898. *Physarum gulielmae* Penzig., *Myx. Beut.*, p. 34.
1909. *Physarum gulielmae* Penzig., Torrend, *Fl. des Myx.*, p. 208.
1911. *Physarum gulielmae* Penzig., List., *Mycetozoa, 2nd ed.*, p. 76.

Plasmodium yellow; sporangia subglobose, sessile, brownish-orange or chestnut brown, rugulose, clustered or heaped, often with a yellow membranous hypothallus; peridium membranous with clustered deposits of yellowish-brown lime granules; capillitium abundant, the nodes angular, branching, white; spores purplish brown, spinulose, 10–12 μ.

Reported from Java, Sweden, Switzerland.

PHYSARUM ECHINOSPORUM *List.*

1899. *Physarum echinosporum* List., *Jour. Bot.*, XXXVII., p. 147.

This species is distinguished from the preceding chiefly in episporic characters. "Spores purple, 8 μ, marked by strong ridges and spines," 8 μ.

Reported from Antigua.

PHYSARUM ÆNEUM *(List.) R. E. Fries.*

1898. *Physarum murinum* var. *aeneum* Lister, *Jour. Bot.*, XXXVI., p. 117.
1903. *Physarum aeneum* Lister, R. E. Fries, *Arkiv. Bot.*, I., p. 62.

Sporangia sessile, subglobose or plasmodiocarpous, pinkish-brown or bronze, glossy; peridium double, the outer somewhat cartilaginous, brittle, falling back from the shining, membranous inner wall; capillitium dense, the nodules not large, brown, sometimes aggregated to form a pseudo-columella; spores pale brownish-violet, nearly smooth, 6–8 μ.

Reported from West Indies, Bolivia.

Related Genus

TRICHAMPHORA *Junghuhn,* p. 12.

1838. *Trichamphora,* Junghuhn, *Fl. Crypt. Javanica.*

Sporangia discoidal, above concave, saucer-shaped, stipitate; the capillitium variable, anon physaroid, badhamioid, or even as in *Didymium.*

This genus is set up for the accommodation thus far of the single species following. It differs from *Physarella* in the apparently constant discoidal shape, absence of trabecules, etc.

TRICHAMPHORA PEZIZOIDEA *Jungh., op. cit.*

1838. *Trichamphora pezizoidea* Jungh., *op. cit.*
1854. *Didymium zeylanicum* Berk. & Br., *Hook. Jour. Bot.,* VI., p. 230.
1869. *Physarum macrocarpum* Fuckel, *Symb. Myc.,* p. 343.
1875. *Chondrioderma pezizoidea* Rost., *Mon.,* p. 424, tab. VIII., Fig. 122.
1876. *Badhamia fuckeliana* Rost., *Mon., App.,* p. 2.
1894. *Trichamphora pezizoidea* Jungh., List., *Mycetozoa,* p. 89.
1911. *Trichamphora pezizoidea* Jungh., List., *Mycetozoa, 2nd ed.,* p. 90.

Sporangia discoidal or saucer-shaped, gregarious, stipitate, erect or nodding, grayish-white, the peridium thin, breaking irregularly and persistent; stipe subulate, striate, reddish brown, transparent; capillitium variable as above stated; spores pale violet-brown, spinulose or nearly smooth, about 9 μ.

In *Mycetozoa, 2nd ed.,* the spores are described as "dark or pale purplish brown, spinose, spinulose or nearly smooth, 9–17 μ in diameter." This would seem too great a variation even in this protean species. The only specimens in our herbarium are from the Congo valley. The spores are pale and nearly smooth, as in *Tilmadoche alba,* and 9 μ. Spores 17 μ suggest immaturity; penultimate cell-division.

The synonymy above cited shows how this species has impressed careful students. Doubtless in every case the reference is correct, judging from the specimen each author had before him, although it is hard to see how *Chondrioderma* might have been suggested.

The species is evidently tropical, though reported from Europe.

4. Craterium *Trentepohl*

1797. *Craterium* Trentepohl, Roth, *Catal.*, I., p. 224.

Sporangia more or less distinctly cyathiform, stipitate, the peridium generally plainly of two layers or even of three, opening at the top by circumscission more or less definite, or by a distinct lid, the upper part calcareous often to a marked degree, the lower, cartilaginous, long persistent as a vasiform cup containing the capillitium and spores, the calcareous nodes aggregating more or less to form a pseudo-columella.

This genus is distinguished from *Physarum* and *Badhamia* chiefly by the form of the sporangia and the method of dehiscence. The capillitium is in some specimens particularly, of the *Physarum* type; in others, like that of *Badhamia*. There are accordingly species that receive at the hands of different authors diverse generic reference as one feature or another in the structure is emphasized in the different cases. It is granted that it is hard to draw the line sometimes between forms in which the dehiscence is irregularly circumscissile and those in which the wall breaks without any regularity whatever, since, in all, the breaking up of the peridium usually begins at the top. Species here included will, however, offer little ambiguity.

Key to the Species of Craterium

A. Dehiscence circumscissile or by the breaking up of the upper wall of of the sporangium.
  a. Sporangia violet or purple . . . 1. *C. paraguayense*
  b. Sporangia yellow . . . . . 2. *C. aureum*
  c. Sporangia white-capped.
    1. Sporangia obovoid or globoid . 3. *C. leucocephalum*
    2. Sporangia cylindric, elongate . 4. *C. cylindricum*

B. Dehiscence by a distinct lid.
  a. Capillitium pale brown . . . . 5. *C. concinnum*
  b. Capillitium white . . . . . 6. *C. minutum*

1. Craterium paraguayense *(Speg.) List.*

1883. *Didymium paraguayense* Speg., *Fung. Guar. Pug.*, 1, p. 141.
1893. *Craterium rubescens* Rex, *Proc. Philad. Acad. Nat. Sci.*, p. 370.
1894. *Craterium rubescens* Rex, List., *Mycetozoa*, p. 71.
1899. *Craterium rubescens* Rex, Macbr., *N. A. S.*, p. 75.
1904. *Iocraterium paraguayense* (Speg.) Jahn, *Hedwigia*, XLII., p. 302.
1911. *Craterium paraguayense* List., *Mycetozoa, 2nd ed.*, p. 95.

Sporangia gregarious, cylindrical or elongate cyathiform, stipitate, dark violet-red, the apex slightly roughened by pale calcareous granules, the peridium longitudinally wrinkled below; dehiscence, irregularly circumscissile; stipe darker, one-half the height of the sporangium, longitudinally wrinkled; capillitium dense, abundantly calcareous; spores violet-brown, minutely roughened, 7–8 μ.

In form resembling the following species, but instantly distinguished by the color, which is red throughout, tinged with purple or violet. The capillitium is badhamioid, as noted by Dr. Rex. Very distinct from *P. newtoni* in color, form, habit, epispore, etc.

2. Craterium aureum *(Schum.) Rost.*

1803. *Trichia aurea* Schum., *Enum. Pl. Saell.*, II., p. 207.
1829. *Craterium mutabile* Fries, *Syst. Myc.*, III., p. 154.
1875. *Craterium aureum* (Schum.) Rost., *Mon.*, p. 125.

Sporangia gregarious, globose or obovoid, stipitate, yellow, erect, the peridial wall thin, especially at the summit, where at maturity it breaks up somewhat reticulately, leaving the persistent lower portion with an uneven margin above which projects the pale yellow capillitium; stipe short, orange, or brownish-red, arising from a small hypothallus; capillitium dense, yellow, the nodules not large, irregular, tending to form a pseudo-columella in the centre of the cup; spores minutely warted, violaceous-brown, 8–10 μ.

Fries regards this, which he names *C. mutabile,* the most distinctly marked species of the genus; chiefly, as it appears, on account of the bright yellow color. This, however, varies. Some specimens before us are gray, showing only a trace of yellow below. In some European specimens a reddish tinge prevails. The form of the sporangium also varies. In typical specimens, unopened, the shape is almost pyriform; opened, we have a cylindric, oftenest lemon-yellow vase, mounted on a short striate stalk. But again, from the same plasmodium, we may have globose sporangia, opening so as to leave only a shallow, salver-shaped base. In this case the stipe is also longer. The plasmodium is said to be "clear lemon yellow." — *Massee.*

There seems little doubt that Schumacher had in mind the present

species in his *Trichia aurea.* Rostafinski shows that Fries's synonym, *C. mutabile,* is founded on a mistake. The earlier specific name is therefore on Rostafinski's authority adopted.

Not common. Pennsylvania, New Jersey, North Carolina, Ohio, Iowa.

3. Craterium leucocephalum *(Pers.) Ditmar.*

Plate VIII., Fig. 5.

1791. *Stemonitis leucocephala* Gmelin, *Syst. Nat.,* II., p. 1467.
1801. *Arcyria* (?) *leucocephala* Persoon, *Syn. Fung.,* p. 183.
1801. *Craterium* (?) *leucocephalum,* Persoon, *Syn. Fung.,* p. 184.
1813. *Craterium leucocephalum* (Pers.) Ditmar, Sturm, *Deutsch. Flora, Pilze,* p. 21, Pl. 11.
1889. *Physarum scyphoides* Cke. & Balf., *Jour. Myc.,* V., p. 186.
1896. *Craterium convivale* (Batsch) Morg., *Jour. Cin. Soc.,* p. 86.

Sporangia gregarious, short-cylindric or ovate, pure white above, brown or reddish-brown below, stipitate, dehiscence irregularly circumscissile, the persistent portion of the peridium beaker-shaped; stipe short, stout, expanded above into the base of the peridium with which it is concolorous; hypothallus scant; capillitium white or sometimes, toward the centre, brownish, the calcareous nodules large, conspicuous, and persistent; spore-mass black, spores violaceous-brown, minutely spinulose, 8–9 μ.

Distinguished by its white cap from all except the next, from which the markedly different form serves as the diagnostic feature. In some gatherings, curious patches of yellow mark the otherwise snow white cap and sides; these are mere stains, or sometimes definite, crystalline, flake-like bodies, standing out in plain relief on the sporangial wall, or lurking in the larger nodules which are massed along the axis of the cup to form the pseudo-columella here strongly developed. Mr. Lister calls attention to these yellow flakes, and regards them as diagnostic. European specimens show the capillitium yellow, sometimes throughout!

The nomenclature question is here somewhat difficult. Fries heads his list of synonyms with *Peziza convivalis* Batsch. Batsch simply described Micheli's figure! Now there is nothing in Micheli's figure (Pl. 86, Fig. 14) to enable one to say with certainty which craterium Micheli had in mind, if craterium at all. Nor does Batsch help the

matter when he offers the description following: "Stipitata; acute conica, patens; stipite subdistincto, lineari, brevi, valido. *Albicans. In foliis hederae putridis.*" (*Elenchus Fungorum,* Batsch, 1783, p. 121.) There is nothing definitive here but the one word "albicans" quoted from Micheli. But this term is applicable the rather to *C. minutum,* the cups of which whiten with weathering. It may be, as insisted by Fries (*Syst. Myc.,* III., p. 149), that Micheli drew crateriums; but if so, we cannot determine which species.

The specific name here adopted was applied by Persoon probably to this form; but Persoon likewise failed to distinguish the present species from *C. minutum* (see *Syn. Fung.,* pp. 183, 184), and Fries, *op. cit.,* p. 153. Ditmar, *l. c.,* leaves no doubt as to what he figures and describes, and accordingly the name he first correctly uses is here adopted.

Not common. New England, Pennsylvania, Ohio, North Carolina, Iowa, Colorado, Washington, California; reported from Europe.

4. Craterium cylindricum *Massee.*

Plate XVI., Fig. 2.

1873. *Craterium minimum* Berk. & C., *Grev.,* II., p. 67.
1892. *Craterium cylindricum* Massee, *Mon.,* p. 268.
1894. *Craterium leucocephalum* Ditm., List., *Myc.,* p. 72, in part.
1899. *Craterium minimum* Berk. & C., Macbr., *N. A. S.,* p. 77.
1911. *Craterium leucocephalum* var. *cylindricum* List., *Mycetozoa, 2nd ed.,* p. 97

Sporangia closely gregarious, very small, .5 μ or less, slender, cylindric, almost entirely white, stipitate, the peridium delicate, transparent although calcareous nearly to the base, opening by a dehiscence regularly circumscissile; stipe short, about one-third the total height, clear orange-brown, somewhat furrowed, rising from an indistinct hypothallus; capillitium very lax, physaroid, the calcareous nodules large, rounded, pure white, aggregated at the centre of the cup; spore-mass black, spores minutely roughened, violaceous-brown, 8–9 μ.

This is the common form in the United States. Massee describes it as *C. cylindricum* Mass., and it seems not to occur in Europe.

Lister has put it in with *C. leucocephalum,* from which its more delicate structure and elegant cylindrical shape certainly distinguish it. The dehiscence is even more regular than in the preceding species and approaches that of *C. minutum* Leers., with bleached forms of which it must not be confused. *N. A. F.,* 1400.

C. minimum Berk. & C. has here priority. Massee regards this name as indicating a distinct species. We have been unable to determine what the authors really had before them, and adopt accordingly the first available combination.

New England to Iowa and south; reported also from the orient.

5. Craterium concinnum *Rex.*

1893. *Craterium concinnum* Rex, *Proc. Phila. Acad.,* p. 370.

Sporangia scattered, usually minute, broadly funnel-shaped, stipitate. The peridium simple, variously colored by innate lime granules, opening by a regular cap or operculum, brownish white, darkest in the centre, always more or less convex; stipe equalling the cup in height, dark brown, longitudinally ridged; the capillitium a close-meshed network, with small rounded or slightly angular masses of ochre-brown lime-granules, larger toward the centre; spores pale brown, minutely warted, 9–10 μ.

This species differs from the following, to which it seems most nearly allied, in form, color, as in the capillitium, and color of the spores. In habitat, however, it seems no less distinct, being found always (?) on the spines of decaying chestnut-burs lying on the ground, and in company with that other peculiar species *Lachnobolus globosus.*

The range is probably that of the chestnut, *Castanea dentata* Borkhausen, east of the Mississippi River.

6. Craterium minutum *(Leers) Fr.*

Plate XV., Fig. 5.

1775. *Peziza minuta* Leers, *Fl. Herborn,* p. 277.
1797. *Craterium pedunculatum* Trent., Roth., *Catal. Bot.,* I., p. 224.
1813. *Craterium vulgare* Ditmar, Sturm, *Deutsch. Fl. Pilze,* p. 17.
1829. *Craterium pedunculatum* Trent., Fr., *Syst. Myc.,* III., p. 150.
1829. *Craterium minutum* Leers, Fr., *Syst. Myc.,* III., p. 151.

1893. *Craterium pedunculatum* Trent., Macbr., *Bull. Lab. Nat. Hist. Iowa,* II., p. 385.
1894. *Craterium pedunculatum* Trent., Lister, *Mycetozoa,* p. 70.
1899. *Craterium minutum* (Leers) Fr., Macbr., *N. A. S.,* p. 78.
1911. *Craterium minutum* Fr., List., *Mycetozoa, 2nd ed.,* p. 94.

Sporangia scattered, gregarious, cyathiform or turbinate, grayish brown, stipitate, the peridial wall rather thick, double, opening by a distinct lid which lies usually below the slightly thickened and everted margin of the cup; stipe paler, translucent, about equalling in height the peridial cup, longitudinally wrinkled, with hypothallus scant or none; capillitium physaroid, the calcareous nodules large, white, and generally aggregated at the centre of the cup; spore-mass black, spores by transmitted light violaceous, minutely warted, 8–10 μ.

This is the most highly differentiated of the whole series. The cup is shapely and well defined, while the lid is not only distinct, but is a thin, delicate membrane of slightly different structure when compared with the peridial wall. It is in all the specimens before us much depressed below the mouth of the sporangium, and the whole structure in our specimens corresponds with Fries' description of *C. pedunculatum* Trent., while specimens received from Europe correspond to Fries' account of *C. minutum* Leers. Nevertheless we are assured that the two forms are in Europe developed from the same plasmodium, and therefore adopt the earlier specific name as above. *N. A. F.,* 2500. This is probably *Fungoides convivalis* of Batsch and Micheli.

In this species yellow sporangia are sometimes seen. Miss Currie reports from Toronto such variation and in Europe the case seems not unusual.

In fact, there is a yellow tinge about the sporangia of every species listed here, except the first. With the same exception, the plasmodium in every case is yellow.

Common throughout the eastern United States, west to Iowa, Colorado, and south to Louisiana; cosmopolitan.

5. Physarella *Peck.*

1882. *Physarella* Peck., *Bull. Torr. Bot. Club,* IX., p. 61.

Sporangium pervious to the base, the interior walls forming a persistent spurious columella; capillitium composed of filaments with

here and there minute knot-like thickenings, straight tubes containing lime-granules extending from the exterior to the interior walls of the sporangium, persistently attached to the former.[1]

Such is Dr. Peck's original description of this most peculiar genus. The form of the sporangium in the only species is very variable, but in typical cases is vasiform, the peridial wall at the apex introverted. The capillitium is like that of *Tilmadoche,* except for the presence of the "straight tubes" emphasized in the original description. These are very remarkable and at once diagnostic. They take origin in the sporangial wall and pass across to the "columella"; but at the dehiscence of the sporangium, in typical cases, they remain attached at the points of origin, projecting as stout spine-like processes.

PHYSARELLA OBLONGA *(Berk. & C.) Morg.*

PLATE VIII., Figs. 4, 4 *a*, 4 *b*, 4 *c*; PLATE XVI., Figs. 1, 1 *a*, 1 *b*, and 6.

1873. *Trichamphora oblonga* Berk. & C., *Grev.,* II., p. 66.
1876. *Tilmadoche oblonga* (Berk. & C.) Rost., *Mon. App.,* p. 13.
1876. *Tilmadoche hians* Rost., *Mon. App.,* p 14.
1882. *Physarella mirabilis* Peck, *Bull. Torr. Bot. Club,* IX., p. 61.
1893. *Physarella oblonga* (Berk. & C.) Morg., *Jour. Cin. Soc.,* p. 79.
1894. *Physarella mirabilis* Peck, List., *Mycet.,* p. 68.
1899. *Physarella oblonga* (Berk. & C.) Morg., Macbr., *N. A. S.,* p. 71.
1911. *Physarella oblonga* Morg., List., *Mycet., 2nd ed.,* p. 91.

Sporangia scattered or gregarious, typically cup-shaped or subinfundibuliform, stipitate, erect or cernuous, but varying through low salver-shaped cups, to irregular applanate and sessile masses, the peridium thin but firm, tawny, roughened by numerous yellowish calcareous scales, at length ruptured above and often reflexed in the form of petal-like segments from which project upwards the spiniform trabecules of the capillitium; stipe when present long, terete, red, arising from a scant hypothallus and extended within the sporangium to meet the tubular "columella"; capillitium of delicate violaceous threads seldom branched or united, radiating from the columella with few calcareous nodular expansions, but supported by stout yellow calcareous trabecules, running parallel to the capillitial threads, long adherent to the sporangial wall; spores smooth, globose violet-brown, 7–8 μ.

[1] These little structures have a fairly architectural appearance and may be called trabecules,—trabeculæ, little beams.

Not uncommon in wet places. New York, Ohio, Iowa, South Dakota, Louisiana, Nicaragua; reported also from Ceylon, Java, etc.

Not the least remarkable feature of this remarkable species is the variation in the form of the fruit or sporangia. We have specimens from Louisiana (Rev. Langlois) which show no trace of columella, the whole structure involute and plicate, short stipitate, recalling the extremest complexity of such a species as *P. polycephalum. Vid.* Pl. XVI., Fig. 6. Moreover, in these specimens the calcareous deposits are white and not yellow, giving the entire fructification a grayish aspect. Yet there is no doubt we have here simply an exaggerated abnormality of the species; the spores are identical in size, color, and surface. Plasmodium bright yellow. Dr. Peck gave to his forms the name *Physarella mirabilis;* but specimens sent by Michener of Pennsylvania, and by Berkeley and Curtis described as *Trichamphora oblonga* (*Grev.,* II., p. 66), are the same thing. *N. A. F.,* 1212.

Physarella lusitanica Torrend is a globose form depressed above or betimes discoidal, occurring on Eucalyptus trees in Portugal. *P. oblonga* is so variable in form that it sometimes suggests a different genus. Forms of it have been mistaken for *Fuligo gyrosa* R., etc. Professor Torrend would include here *Physarum javanicum* (Rac.), i. e. *Tilmadoche javanica* as Raciborski saw it! We may not too often reflect that genera are purely artificial things set up for our convenience; but surely *Physarella* as a natural genus is distinct enough to all.

Cienkowskia *Rost.*

1873. *Cienkowskia* Rost., *Versuch,* p. 9.

Fructification plasmodiocarpous, irregularly dehiscent, the wall a thin cartilaginous membrane destitute of lime, except the capillitial attachments within; capillitium scanty but rigid, and characterized everywhere by peculiar hook-like branchlets, free and sharp-pointed, the spores as in *Physarum,* etc.

The genus contains, so far, but a single species: —

CIENKOWSKIA RETICULATA *(Alb. & Schw.) Rost.*

PLATE XIV., Figs. 2, 2 *a*, 2 *b*.

1805. *Physarum reticulatum* Alb. & Schw., *Cons. Fung.*, p. 90.
1829. *Diderma reticulatum* Fr., *Syst. Myc.*, III., p. 112.
1873. *Cienkowskia reticulata* (Alb. & Schw.) Rost., *Versuch*, p. 9.

Plasmodiocarp an elongated, irregularly limited, close-meshed net, closely applied to the substratum, the wall thin, transversely rugulose, and roughened, dull orange-yellow, splashed here and there with scarlet, anon entirely red, within marked by transverse calcareous ridges, supporting in part the calcareous system of the capillitium; capillitium of delicate, rigid, reticulating yellow tubules or threads with numerous free, uncinate or sickle-shaped branchlets, and large, irregular, calcareous plates, more or less transverse to the axis of the sporangium, attached to the peridial walls, as if to form septa, ordinary calcareous nodules few; spore-mass jet-black, spores, by transmitted light, violaceous, minutely roughened, 9–10 μ.

A very rare species, as it appears, easily recognized by the Coddington even, much more by the microscopic characters quoted; probably often overlooked by the collector, as to the naked eye it presents the appearance of some imperfectly developed, dried-up plasmodium. Very unlike *Physarum serpula* Morgan, not infrequently offered by collectors as *Cienkowskia.* It is *Diderma reticulatum* of Fries, who, strangely enough, thought it might be a plasmodial phase of *Diderma* (i. e. *Leocarpus*) *fragile* (*Syst. Myc.*, III., p. 102).

Eastern United States, Europe, Java, Ceylon, California. See under *L. fragilis,* next following.

7. **Leocarpus** (*Link*) *Rost.*

1809. *Leocarpus* Link, *Diss.*, I., p. 25.

Sporangia sessile, or short stipitate; peridial wall double, the outer thick, destitute of lime, polished, shining within and without, the inner very delicate, enclosing the capillitium and spores; capillitium of two, more or less, distinct systems, the one a delicate network of hyaline, limeless threads, the other calcareous throughout, or nearly so, the meshes large and the threads or tubules broad; columella none, although a pseudo-columella may sometimes be detected.

This genus was by Link established on characters purely external. Rostafinski supplemented Link's definition by calling attention to the peculiar character of the capillitium and to microscopic characters in general. The outer peridium is thick and strong, unlike the ordinary structure in *Physarum*. Some physarums, however, have a very similar outer wall; *P. brunneolum,* for instance; compare the peridium of *P. citrinellum*. In dehiscence and structure there is also some resemblance to some species of *Diderma,* and by Persoon and Fries the common species was so referred, but the capillitium is again definitive.

A critical study of all these things really begins with Rostafinski's microscope. Under his definition of the present genus *P. squamulosum* Wingate and *P. albescens* Ell. might well be entered here. Such course at present would but increase confusion, and until by future research the ontogeny of all these, and so their relationship, shall be more exactly known, the genus may be left with its historic species,—montotypic.

Leocarpus fragilis *(Dickson) Rost.*

Plate VIII., Figs. 3, 3 *a,* 3 *b.*

1785. *Lycoperdon fragile* Dickson, *Fasc. Pl. Crypt. Brit.,* I., p. 25.
1795. *Diderma vernicosum* Persoon, *Ust. Ann. Bot.,* XV., p. 34.
1809. *Leocarpus vernicosum* Link, *Diss.,* I., p. 25.
1875. *Leocarpus fragilis* (Dicks.) Rost., *Mon.,* p. 132.

Sporangia gregarious or clustered, sessile or stipitate, obovoid, rusty or spadiceous-yellow, shining; peridium opening at maturity in somewhat stellate fashion; stipe filiform, white or yellow, weak and short; spores dull black, spinulose, 12–14 μ.

A common species, distributed through all the world, Iowa to Tasmania. Recognizable at sight by the form and color of the sporangia. In shape and posture these resemble the eggs of certain insects, and, occurring upon dead leaves, generally where these have drifted against a rotten log, they might perchance be mistaken for such structures. With no other slime-moulds are they likely to be confused. The outer peridium opens irregularly, or more rarely

stellately. At centre of the capillitium is a calcareous core. The plasmodium is yellowish white, spread in rich and beautiful reticulations. *N. A. F.*, 1123.

A plasmodiform gathering of this species which will be mistaken for an entirely different thing, is yellow, sessile, and has *adherent* spores; looks like a badhamia, but is after all a leocarpus and probably belongs here. The spores are irregularly clustered and the badhamioid section of the capillitium seems now dominant.

California.

B. DIDYMIACEÆ

Key to the Genera of the Didymiaceæ

1. Fructification æthalioid - . . . . . 1. *Mucilago*
2. Fructification plasmodiocarpous, or forming more often distinct sporangia.
   - *a.* Calcareous deposits crystalline, stellate . . 2. *Didymium*
   - *b.* Calcareous deposits amorphous, peridium double 3. *Diderma*
   - *c.* Calcareous deposits in form of scattered scales 4. *Lepidoderma*
   - *d.* Peridium double, the outer gelatinous . . 5. *Colloderma*

1. Mucilago *(Mich.) Adans.*

1729. *Mucilago* Micheli, *Nov. Pl. Gen.*, in part.
1763. *Mucilago* (Mich.) Adanson, *Fam. des Pl.*, II., p. 7.
1791. *Spumaria* Pers. in Gmelin, *Syst. Nat.*, II., p. 1466.

Fructification æthalioid, consisting generally of large cushion-shaped masses covered without by a white foam-like crust; within, composed of numerous tubular sporangia, developed from a common hypothallus, irregularly branched, contorted and more or less confluent; the peridial wall thin, delicate, frosted with stellate lime-crystals, which mark in section the boundaries of the several sporangia; capillitium of delicate threads, generally only slightly branched, terminating in the sporangial wall, marked with occasional swellings or thickenings.

By the descriptions offered by most authors, and especially by Rostafinski's figures (*Mon.*, Pl. ix.), a pronounced columella is called for in the structure of *Spumaria*. The individual sporangia rise from a common hypothallus, and occasionally portions of this run up and

give to a sporangium the appearance of being stipitate. Sometimes also this upper extension of the hypothalline protoplasm passes beyond or behind the base of the sporangium or between two or more, and is more or less embraced by these in their confluent flexures. This, it seems, suggested Rostafinski's elaborate diagram, Fig. 158; at least, none other form of columella is shown by American materials at hand.

1. Mucilago spongiosa *(Leyss.) Morgan.*

1783. *Mucor spongiosus* Leysser, *Fl. Hal.*, p. 305.
1791. *Reticularia alba* Bull., *C. Fl. France*, p. 92.
1791. *Spumaria mucilago* Pers., Gmel., *Syst. Nat.*, II., 1466.
1805. *Spumaria alba* (Bull.) DC., *Fl. Fr.*, II., p. 261.
1897. *Mucilago spongiosa* (Leyss.) Morg., *Bot. Gaz.*, XXIV., p. 56.

Æthalium white or cream-colored, of variable size and shape, half-an-inch to three inches in length and half as thick, the component sporangia resting upon a common hypothallus and protected by a more or less deciduous calcareous porous cortex; peridial walls thin, and where exposed iridescent, generally whitened by a thin coating of lime crystals; capillitium scanty, of simple, mostly dark-colored, slightly anastomosing threads; columella indefinite or none; hypothallus white, spongy; spore-mass black, spores violaceous, exceedingly rough, large, 12–15 μ.

Very common in all the eastern United States and the Mississippi valley, south to Texas. The plasmodium is dull white, of the consistence of cream, and is often met with in quantity on beds of decaying leaves in the woods. In fruiting the plasmodium ascends preferably living stems of small bushes, herbaceous plants, or grasses, and forms the æthalium around the stem some distance above the ground. The cortex varies in amount, is also deciduous, so that weathered or imperfectly developed forms probably represent the var. *S. cornuta* Schum.

Two varieties of this species are recognized; the one from Bolivia, var. *dictyospora* described by Mr. R. E. Fries (*Arkiv. for Botanik* Bd. 1, p. 66) differs from the type chiefly in its finer capillitial threads its darker spores with longer spines and fine reticulate sculpture; the other from Colorado, var. *solida* described by Professor

Sturgis differs, as the name implies, principally in its greater compactness and slightly smaller calcareous crystals; a desert phase.

2. Didymium *(Schrad.) Fr.*

1797. *Didymium* Schrad., *Nov. Gen. Plant.*, p. 20, in part.
1829. *Didymium* (Schrad.) Fr., *Syst. Myc.*, III., p. 113.
1875. *Didymium* (Schrad.) DeBy., Rost., *Versuch*, p. 13.

Sporangia distinct, stipitate, sessile or even plasmodiocarpous, never æthalioid; the peridium thin, irregular in dehiscence, covered with a more or less dense coating of calcareous crystals; columella more frequently present; capillitium of delicate threads, simple or sparingly branched, extending from the columella to the peridial wall.

The genus *Didymium,* as set up by Schrader *l. c.,* included a number of species now assigned to *Diderma, Lepidoderma* or *Lamproderma.* Fries set out the didermas; DeBary and Rostafinski completed the revision by setting out the remaining alien forms.

The genus is among Myxomycetes instantly recognized by the peculiar form of its calcareous deposits, stellate crystals coating, or merely frosting, usually distinct sporangia.

Key to the Species of Didymium

1. Lime-crystals merely whitening the peridial wall.
   - A. Fructification plasmodiocarpous.
     - *a.* White.
       - * Capillitium with adherent vesicles 1. *D. complanatum*
       - ** Capillitium simple . . . . 2. *D. anellus*
       - *** Capillitium much combined; spores 10–13 μ 3. *D. wilczekii*
       - **** Capillitium crystal-bearing . 18*a*. *D. anomalum*
     - *b.* Yellow or tawny . . . . . 4. *D. fulvum*
   - B. Fructification normally of distinct sporangia.
     - *a.* Sporangia sessile or nearly so; outer calcareous wall conspicuously developed . . . . 5. *D. crustaceum*
     - *b.* Sporangia plainly stipitate.
       - i. Peridium much depressed; umbilicate below.
         - * Stipe white . . . 6. *D. squamulosum*
         - ** Stipe black.
           - † Larger, about 7.5–1 mm. 7. *D. melanospermum*
           - †† Small, about .5 mm. . 8. *D. minus*
           - ††† Sporangia discoid . 9. *D. clavus*

ii. Peridium small, globose.
* Stipe dark brown or black; columella dark, obsolete or none . . . 10. *D. nigripes*
** Stipe generally paler, of various tints of brown, orange, etc.
† Columella pale or white, nearly smooth 11. *D. xanthopus*
†† Columella, yellow, discoid, rough 12. *D. eximium*
iii. Peridium turbinate, columella hemispheric 13. *D. trochus*
iv. Peridium annulate . . . 14. *D. annulatum*

2. Calcareous crystals forming a distinct crust.
A. Fructification wholly plasmodiocarpous . . 15. *D. dubium*
B. Sporangia ill-defined, sessile, plasmodiocarpous.
a. Spores generally nearly smooth . . 16. *D. difforme*
b. Spores very rough, obscurely banded . 17. *D. quitense*

EXTRA-LIMITAL

a. Sporangia discoid, spores reticulate 19. *D. intermedium*
b. Stipe, columella, peridium, orange-brown 20. *D. leoninum*

1. Didymium complanatum *(Batsch) Rost.*

Plate XVI., Fig. 8.

1786. *Lycoperdon complanatum* Batsch, *Elench. Fung.*, I., p. 251.
1829. *Didymium serpula* Fr., *Syst. Myc.*, III., p. 126, Rost., *App.*, p. 21.
1875. *Didymium complanatum* (Batsch), Rost., *Mon.*, p. 151.
1899. *Didymium complanatum* (Batsch) R., Macbr., *N. A. S.*, p. 85.
1911. *Didymium complanatum* Rost., List., *Mycetozoa, 2nd ed.*, p. 127.

Fructification plasmodiocarpous, creeping, flattened, vein-like, annulate or reticulate, the dark-colored peridium covered with white, but not numerous crystals; hypothallus none; columella none; capillitium much branched, violaceous threads combined to form a rather dense net which bears numerous, peculiar, rounded vesicles, yellowish in color, 30–50 μ in diameter; spores minutely warted, 7–9 μ, violaceous-brown.

The defining characteristics here are the curious supplementary vesicles. These are evidently plasmodic, embraced, shot-through, by all the neighboring capillitial threads, withal warted like a spore. They remind of the curious, belated, spore-like but giant cells found in stipes, as in arcyriaceous forms. With all the wealth of his prolix,

poetic, metaphoric tongue, the Polish author gives them abundant consideration. In the *Mon.,* Tab. IX., Figs. 166 and 180, he clearly shows the structure, although in the explanation of the plate he has strangely mixed this species with *D. crustaceum* Fr. Under *D. serpula* Fries may refer to the present species, although there is nothing in his description to determine the fact. The same thing may be said of the description and figures of Batsch. Rostafinski, in the *Monograph,* seems to have been satisfied as to the identity of Batsch's materials: in the *Appendix,* he writes *D. serpula,* but gives no reason.

Rare. New York. England, France, Germany.

2. Didymium anellus *Morgan.*

Plate XVIII., Fig. 7.

1894. *Didymium anellus* Morgan, *Jour. Cin. Soc.,* p. 64.
1899. *Didymium anellus* Morg., Macbr., *N. A. S.,* p. 85.
1911. *Didymium anellus* Morg., Lister, *Mycetozoa, 2nd ed.,* p. 134.

Plasmodiocarp in small rings or links, then confluent and elongated, irregularly connected together, bent and flexuous, resting on a thin venulose hypothallus, or sometimes globose, the peridium dark colored, with a thin layer of stellate crystals, irregularly ruptured; capillitium of slender, dark-colored threads, which extend from base to wall, more or less branched, and combined into a loose net; columella a thin layer of brown scales; spores globose, very minutely warted, violaceous, 8–9 μ.

This minute species resembles a poorly developed, or sessile, phase of *D. melanospermum.* Some of the sporangia (?) are spherical; such show a very short dark stalk. The columella is scant, and the spores are smaller than those of *D. melanospermum.*

Ohio. Reported more recently from Europe and Ceylon.

3. Didymium wilczekii *Meylan.*

1908. *Didymium wilczekii* Meyl., *Bull. Soc. Vaud. Sci. Nat.,* XLIV., p. 290.
1911. *Didymium wilczekii* Meyl., List., *Mycetozoa, 2nd ed.,* p. 134.

Plasmodiocarpous, dehiscing irregularly, columella scant; capillitium abundant, the threads brown, anastomosing, forming an elastic net; spores purple-brown, minutely spinulose, 10–12 μ.

Resembling plasmodiocarpous forms of *D. squamulosum,* a montane var.; small and delicate, our specimen about 16×6 mm. Evidently not common; collected but once by Professor Bethel at an altitude of 11,000 feet, Rocky Mountains of Colorado.

Reported in Switzerland and Sweden.

In certain Swiss gatherings made in 1913 Miss Lister finds capillitial threads with *spiral* tæniæ as in *Trichia!* (*Jour. of Bot.,* Apr. 1914.) The threads in our specimen are roughened, somewhat as in *D. squamulosum,* though less strongly; the spores are nearly smooth, fuliginous at first, paler and violaceous when saturate.

4. Didymium fulvum *Sturgis.*

1917. *Didymium fulvum* Sturgis, *Mycologia,* IX., p. 37.

Sporangia gregarious, sessile, elongate or forming curved plasmodiocarps, sometimes confluent, rarely subglobose, concave beneath, pale-raw-umber in color, 0.5–0.8 mm. in diameter, occasionally seated on a concolorous, membranous, lime-encrusted hypothallus which may form pseudo-stalks; sporangium wall membranous, stained with yellow blotches, thickly sprinkled with clusters of large acicular crystals of pale-yellowish lime; columella very much flattened or obsolete; capillitium an abundant network of delicate, almost straight or flexuose, pale-purple or nearly hyaline threads, frequently with dark, calyciform thickenings as in *Mucilago,* and occasionally showing fusiform, crystalline blisters; spores dark-purplish-brown, coarsely tuberculate, the tubercles usually arranged in curved lines, paler and smoother on one side, 12.5 to 14.5 μ. Colorado.

5. Didymium crustaceum *Fr.*

1829. *Didymium crustaceum* Fr., *Syst. Myc.,* III., p. 124.

Sporangia closely aggregated, globose, or by compression deformed, sessile, snow-white, by virtue of the remarkably developed covering of calcareous crystals by which each sporangium is surrounded as if to form a crust, the peridium membranous, colorless, usually shrunken above and depressed; columella pale, small, or obsolete; hypothallus scant or vanishing; capillitium of rather stout violaceous threads seldom branched except at the tips, where they are pale and often

bifid, or more than once dichotomously divided; spores strongly warted, globose, violet-brown, 10–13 μ.

This species has in some ways all the outward seeming of a diderma, but cannot be referred to that genus because of the crystalline character of its crust. This is a very marked structure; loosely built up of very large crystals, it is necessarily extremely frail, nevertheless persists, arching over at a considerable distance above the peridium proper. Sometimes, however, caducous, evanescent.

The sporangia are said to be sometimes stipitate. This feature does not appear in any of the material before us. Lister in *Mycetozoa* Pl. XL., *c*. draws the capillitium much more delicate than it appears in our specimens. The hypothallus is sometimes noticeable under some of the sporangia where closely crowded, but is not a constant feature.

Rostafinski (by typographical error?) confused in the *Monograph,* pp. 164, 165, this species with Persoon's *Physarum confluens.* In the *Appendix* he substitutes the Friesian nomenclature. Persoon's description of his species is insufficient, and throws no light on the problem whatever.

Rare. Iowa; Black Hills, South Dakota. Reported common in Europe. Canada; Vancouver Island to the St. Lawrence.

6. DIDYMIUM SQUAMULOSUM *(Alb. & Schw.) Fries.*

1805. *Diderma squamulosum* Alb. & Schw., *Consp. Fung.,* p. 88.
1816. *Didymium effusum* Link, *Diss.,* II., p. 42.
1829. *Didymium squamulosum* (Alb. & Schw.), Fries, *Syst. Myc.,* III., p. 118.
1875. *Didymium effusum* (Link) Rost., *Mon.,* p. 163.
1894. *Didymium effusum* (Link) List., *Mycetozoa,* p. 99.

Sporangia, in typical forms, gregarious, globose or depressed-globose, gray or snow-white, stipitate; the peridium a thin iridescent membrane covered more or less richly with minute crystals of lime; the stipe when present, snow-white, fluted or channelled, stout, even; columella white, conspicuous; hypothallus usually small or obsolete; capillitium of delicate branching threads, usually colorless or pallid, sometimes with conspicuous calyciform thickenings; spores violaceous, minutely warted or spinulose, 8–10 μ.

This, one of the most beautiful species in the whole series, is remarkable for the variations which it presents in the fruiting phase. These range all the way from the simplest and plainest kind of a plasmodiocarp with only the most delicate frosting of calcareous crystals up through more or less confluent sessile sporangia to well-defined elegantly stipitate, globose fruits, where the lime is sometimes so abundant as to form deciduous flaky scales. The hypothallus, sometimes entirely wanting, is anon well developed, even continuous, venulose, from stipe to stipe. The capillitium varies much in abundance as in color; when scanty, it is colorless and in every way more delicate, when abundant, darker in color and sometimes with stronger thickenings.

D. fuckelianum Rost., as shown in *N. A. F.,* 2090, and in some private collections, seems to be a rather stout phase of the present species; the stipe is more abundantly and deeply plicate, is sometimes tinged with brown, and the capillitium is darker colored and coarser than in what is here regarded as the type of the species; but withal the specimens certainly fail to meet the requirements of Rostafinski's elaborate description and figure, *Mon.,* p. 161 and Fig. 154.

D. effusum Link. probably stands for a sessile form of this species, but Link's brief description (1816) is antedated by the much better one of Albertini and Schweinitz, *l. c.*

Generally distributed throughout the wooded regions of North America, from New England to Nicaragua, and from Canada to California. Not uncommon about stable-manure heaps, in flower beds, and on richly manured lands. July, August.

Nicaragua specimens not only show a continuous vein-like hypothallus, but have the peridia often confluent, the columellæ in such cases confluent, the stipes distinct. Furthermore, the largest spores reach the limit of 12.5 μ, and perhaps the larger number range from 10–12.5 μ, and all are very rough. This corresponds with *D. macrospermum* Rost., which is distinguished, says the author (*Mon.,* p. 162, *opis*), "chiefly by the large and strongly spinulose spores." However, the same sporangium in our Central American specimens yield spores 9.5–12.5 μ, a remarkable range. So that *D. macrospermum* on this side the ocean, at least, cannot be distinguished from

D. squamulosum, as far as spores are concerned. A similar remark may be made relative to the form of the columella which Rostafinski, in his figures especially, would make diagnostic. The columella in the sporangia with largest and roughest spores is that of a perfectly normal *D. squamulosum.*

7. Didymium melanospermum *(Pers.) Macbr.*

Plate VII., Figs. 3, 3 *a.*

1794. *Physarum melanospermum* Pers., *Röm. N. Mag. Bot.,* p. 89.
1797. *Didymium farinaceum* Schrader, *Nov. Gen. Pl.,* p. 26, t. 5, Fig. 6.

Sporangia gregarious, hemispheric, depressed, umbilicate below, stipitate or sessile; the peridium firm, dull brown in color, frosted with minute crystals of lime, breaking irregularly; stipe, when present, short, stout, dull black, opaque, arising from a broad base or hypothallus; columella large, prominent; dark-colored, rough above, concave below; capillitium of more or less sinuous, usually dark-colored threads, sparingly branched, and often with calyciform thickenings; spore-mass black, spores by transmitted light pale, purplish-gray, spinulose or rough, 10–12 μ.

A well-marked and common species, distinguished by its depressed sporangium and dark-colored, opaque stipe. The latter is usually very short, almost completely concealed in the concavity of the umbilicate sporangium. The columella is dark-colored, forming the floor of the peridial cavity.

Persoon first named this species as here. Later on, *Uster's Ann.,* XV., 6, he substituted *villosum* as a more appropriate specific name. Schrader rejects both names given by Persoon as unsuitable, and suggests *farinaceum.* Schrad., *op. cit.,* p. 27.

New England, Ohio, Missouri, Alabama, Iowa, Nebraska; Europe; probably cosmopolitan.

8. Didymium minus *Lister.*

Plate X., Figs. 4, 4 *a,* 4 *b.*

1892. *Didymium farinaceum* Schr., var. *minus,* List., *Mycetozoa,* p. 97.
1896. *Didymium minus* List., Morg., *Jour. Cin. Soc.,* p. 61.
1899. *Didymium minus* List., Macbr., *N. A. S.,* p. 89.

Sporangia gregarious, depressed-globose, umbilicate below, whitish or gray, small, about ½ mm., stipitate; stipe erect, rather slender, black, faintly striate, about equal to the sporangium in the horizontal diameter; columella distinct, dark brown, globose or depressed-globose, attaining in some cases the centre, rough; capillitium delicate, almost colorless, radiating, sparsely branched; spores in mass dark brown, by transmitted light violet-tinted, minutely roughened, 8–10 μ.

Probably more common than the preceding, and generally mistaken for it. Distinguished by its smaller size, longer and more slender stem, and general trim, well-differentiated appearance. Certainly very near the preceding, of which Mr. Lister regards it as merely a variety. Professor Morgan thought it in this country the more common form.

New York, Ohio, Iowa; reported from Europe, Africa, South America.

9. Didymium clavus *(Alb. & Schw.) Rabenhorst.*

1805. *Physarum clavus* Alb. & Schw., *Consp. Fung.*, p. 96.
1829. *Didymium melanopus* Fries, *Syst. Myc.*, III., p. 114.
1844. *Didymium clavus* (Alb. & Schw.) Rabh., *Ger. Cr. Fl.*, No. 2282.
1875. *Didymium clavus* (Alb. & Schw.) Rost., *Mon.*, p. 153.
1899. *Didymium clavus* (Alb. & Schw.) Rabenh., Macbr., *N. A. S.*, p. 90.
1911. *Didymium clavus* Rost., List., *Mycet., 2nd ed.*, p. 128.

Sporangia gregarious, pale gray, discoid or pileate, depressed, stipitate; the peridium dark-colored, frosted with calcareous crystals above, naked below; stipe short, slender, tapering upward, furrowed, arising from a hypothallus more or less distinct, black; columella obsolete; capillitium of delicate threads, pale or colorless, little branched; spores violaceous, pale, nearly smooth, 6–8 μ.

This species is well differentiated, easy of recognition by reason of its peculiar discoid sporangium, calcareous above, naked and black beneath. *D. neglectum* Massee, reported from Philadelphia, is said to be a slender form of the present species. The figures of *D. clavus* by Albertini and Schweinitz are excellent, as also the description.

Not common. Pennsylvania, Ohio, Iowa.

10. Didymium nigripes *(Link) Fries.*

Plate VII., Figs. 2, 2 *a*, 2 *b*.

1809. *Physarum nigripes* Link, *Obs. Diss.*, I., p. 27.
1818. *Physarum microcarpon* Fr., *Sym. Gast.*, p. 23.
1829. *Didymium nigripes* (Link) Fr., *Syst. Myc.*, III., p. 119.
1875. *Didymium microcarpon* (Fr.) Rost., *Mon.*, p. 157.
1896. *Didymium microcarpon* Fr., Morg., *Jour. Cin. Soc.*, p. 61.

Sporangia gregarious, globose or hemispheric, umbilicate beneath, small, white, stipitate; the peridium smoky, covered with minute calcareous crystals; stipe slender, erect, black, opaque; hypothallus scutate, black; columella distinct, globose, black or dark brown; capillitium of delicate threads, pale brown or colorless, with occasional brown thickenings or nodes, sparingly branched; spores pale, violaceous by transmitted light, minutely warted, 6–8 μ.

This is *D. microcarpon* Rost. Fries, *l. c.*, acknowledges the priority of Link's appellation, and discards *microcarpon*. Rostafinski adopted *microcarpon* simply because he thought it more appropriate. Fries describes the columella "none or black." It is doubtful whether we have the typical Friesian form on this continent. The fructification is in our specimens small, about .4 mm., and the spores, as noted by Morgan, small; otherwise the species is hardly more than a variety of the next. Under the name *D. nigripes* Lister groups our Nos. 10, 11, 12. *N. A. F.*, 1393, represents Dr. Rex's conception of the present species.

Not common. New York, Ohio, Iowa.

11. Didymium xanthopus *(Ditmar) Fr.*

Plate XVI., Fig. 10.

1817. *Cionium xanthopus* Ditmar, Sturm, *Deutsch. Fl.*, III., p. 37, t. 43.
1829. *Didymium xanthopus* (Dit.) Fr., *Syst. Myc.*, III., p. 120.
1873. *Didymium proximum* Berk. & C., *Grev.*, II., p. 52.
1892. *Didymium microcarpon* (Fr.) Rost., Macbr., *Bull. Lab. Nat. Hist. Iowa*, II., p. 146, in part.
1894. *Didymium nigripes* Fr., List., *Mycetozoa*, p. 98, in part.

Sporangia gregarious, white, globose, slightly umbilicate, stipitate; the peridium thin, and nearly or quite colorless, frosted with crystals of lime; the stipe yellowish or yellowish brown, corneous, erect, sub-

ulate, slender; hypothallus none; columella pale or white, turbinate, globose or depressed-globose; capillitium of dull brown, or colorless threads more or less branched, always white at the tips; spores violaceous, nearly smooth, 7.5–8.5 μ.

This seems to be the most common form in the United States. It is distinguished from the preceding by the longer, more delicate, generally orange-yellow, stem with pale or white columella. The spores also average a shade larger. *N. A. F.*, 412 and 2089, are illustrations of *D. xanthopus*. The columella in blown-out specimens is very striking, well confirming the diagnosis of Fries, *"valde prominens, globosa, stipitata, alba."* Berkeley makes the color of the capillitium diagnostic of *D. proximum*, but this feature is insufficient.

Eastern United States; common.

12. Didymium eximium *Peck.*

Plate XVI., Figs. 11, 11 *a*, 11 *b*.

1879. *Didymium eximium* Peck, *Rep. N. Y. Mus.*, XXXI., p. 41.

Sporangia scattered, dull grayish-yellow or gray, depressed-globose, umbilicate, minute, stipitate; the peridium comparatively thick, tenacious, especially persistent below, tawny or yellow; the stipe pale brown or orange, erect, even or slightly enlarged at base; hypothallus scant or none; columella prominent, more or less discoidal, rough, or spinulose, especially on the upper surface, yellow; capillitium not abundant, pale fuliginous, often branching and anastomosing so as to form a loose net; spores nearly smooth, dark violaceous by transmitted light, 8.5–9.5 μ.

The species differs from *D. xanthopus* in several particulars, — in the much firmer, more persistent, and less calcareous peridium, in the more complex capillitium, in the darker and larger spores, and especially in the peculiar and prominent columella, which is not only rough, but even "sometimes spinulose even to the extent of long spicules penetrating to one-third the height of the sporangia." *N. A. F.*, 2493.

As stated under No. 8, these last two species are called varieties only of *D. nigripes*. They are so retained in *Mycetozoa, 2nd ed.*

Since, however, they are the usual presentation of the species in the United States, it seems wise to let them stand for the present, as here. They are quite distinguishable; *D. eximium* especially well marked.

Apparently rare, it yet ranges from New York to eastern Iowa, in colonies rather large. Okoboji Lake; — fine!

13. Didymium trochus *List.*

1898. *Didymium trochus* List., *Jour. Bot.,* XXXVI., p. 164.

Sporangia plasmodiocarpous, hemispherical or turbinate, white, sessile or very short-stalked, cream-colored or white; peridium double, the outer shell-like, the inner membranaceous, more or less adherent to the outer, both caducous together, leaving the thickened base surrounding an expanded columella; stipe, when present, very short, stout; capillitium colorless, nearly simple; spores brownish-purple, strongly warted, 9–10 μ.

On decaying leaves, rotten cactus, yucca, etc., Monrovia, California; *Bethel.*

Reported from England on beds of leaves or straw; in Portugal Dr. Torrend finds it on or *in* dead leaves of *Agave americana!* Evidently an American species, and belonging to arid regions; its occurrence in England surprising!

14. Didymium annulatum *Macbr. n. s.*

Plate XX., Figs. 4, 4 *a.*

Sporangia small, scattered, annulate, not only without columella but perforate when the stipe is broken, umbilicate above and below, grey, coated with crystalline frustules, opening irregularly about the periphery; stipe white, or pallid, fluted, tapering upward from a distinct hypothallus; capillitium scanty consisting of delicate, sparsely branching threads, the branchlets anastomosing more or less at length, attached to the peridial wall, radiating from the rim of the slightly depressed top of stipe, without special thickenings save at the insertion of the ramules a triangular enlargement is usual and of dark or pallid shade; spores smooth; however they show three or four spots

on the hemisphere and other minute but variable markings; 9–10 μ. Seattle, Washington.

Differs from *D. nigripes* in color of the stipes, capillitium, spore-diameter, etc.

15. Didymium dubium *Rost.*

1875. *Didymium dubium* Rost., *Mon.*, p. 152.
1892. *Didymium listeri* Mass., *Mon.*, p. 244.
1894. *Didymium dubium* Rost., List., *Mycetozoa*, p. 95.
1911. *Didymium dubium* Rost., List., *Mycetozoa, 2nd ed.*, p. 126.

Fructification wholly plasmodiocarpous, snow-white, small, 2–6 mm., flat and thin; the outer wall double, membranous within, calcareous-crystalline without; columella none; capillitium simple of rather thick, vertical, brown threads, sparingly united laterally, and only occasionally furcate at the ends, especially above; spores minutely spinulescent, violaceous pale, 12–15 μ.

Massee thought English specimens out of harmony with the original description and gave them a new name. To refuse this, Lister enlarges the range of spore-measurements and disregards some of Rostafinski's specifications as to capillitium. Our specimens are as described.

Bohemia. England. Shores of Lake Okoboji, Iowa.

This is indeed a doubtful form. It differs from *D. difforme* chiefly in that the outer calcareous shell is not smooth, but is covered with abundant loose crystals, frosted. The spores are paler but about the same size. The frosting may be incident to local climatic conditions at the time and place of desiccation.

16. Didymium difforme *Duby.*

1797. *Diderma difforme* Pers. *Tentamen Disp. Meth.*, p. 19.
1830. *Didymium difforme* Duby., *Bot. Gall.*, ii., p. 858.
1875. *Chondrioderma difforme* Pers., Rost., *Mon.*, p. 177.
1894. *Didymium difforme* Duby., List., *Mycetozoa*, p. 94.
1899. *Diderma personii* Macbr., *N. A. S.*, p. 96.
1911. *Didymium difforme* Duby., List., *Mycetozoa, 2nd ed.*, p. 124.

Plasmodiocarpous, the smooth, white outer peridium separable from the thin, colorless or purplish inner layer; capillitium of rather

coarse, flat, dichotomously branching threads, broader below; spores minutely warted, or almost smooth, dark brown, 12–14 μ.

The white crust-like outer wall has more than once carried this species into *Diderma*. It is still doubtful whether we are here dealing with *Chondrioderma calcareum* Rost. Miss Lister cites a variety, *S. difforme comatum,* with more abundant capillitium which may represent Rostafinski's species.

Evidently rare in the United States; reported more common in Europe and eastward. In our specimens the crust-like outer peridium shows crystals on the broken edge only; the body of the object, as its outer surface seems to be amorphous.

17. Didymium quitense *(Pat.) Torr.*

1895. *Chondrioderma quitense* Pat., *Bull. Soc. Myc. Fr.,* XI., p. 212.
1909. *Didymium quitense* (Pat.) Torr., *Flor. Myxom.,* p. 150.
1911. *Didymium quitense* Torr., List., *Mycetozoa, 2nd ed.,* p. 126.
1913. *Didymium quitense* (Pat.) Torr., Sturg., *Myx.,* Col. II., p. 446.

Sporangia more or less plasmodiocarpous, scattered, depressed, white; the outer peridium distinct, crust-like, remote from the thin membranous inner wall; columella undefined; capillitium brown, much branched, forming a network especially outwardly; spores very dark violaceous-brown, rough with a tendency to obscure reticulation; 12–14 μ.

This species is different from *D. difforme* chiefly in the rougher and somewhat banded epispore. It is reported from Ecuador by Father Torrend, and from Colorado mountains by Dr. Sturgis to whose kindness I am indebted for the specimens here described. Evidently a high mountain species.

Colorado.

18*a*. Didymium anomalum *Sturg.*

Plate XIX., Figs. 13 and 13 *a*.

1913. *Didymium anomalum* Sturg. *Myxomycetes of Col.,* II., p. 444

Sporangia in the form of very thin effused grey plasmodiocarps, 2–10 cm. long, 1 mm. or less in thickness. Wall single or membranous, hyaline or yellowish, with rather scanty deposits of small, stel-

lately crystalline or amorphous lime. Columella none. Capillitium consisting entirely of straight membranous, tubular, columns, extending from the base to the upper wall of the plasmodiocarp, 7–22 μ thick and usually containing small crystalline masses of lime. Spores bright violet-brown, minutely and irregularly spinulose, 10–11.5 μ diam.

Hab. on the inner bark of Populus. Colorado Springs, Colo., July 1911.

Our specimens by the courtesy of Dr. Sturgis.

EXTRA-LIMITAL

18. Didymium intermedium *Schroeter.*

1896. *Didymium intermedium* Schroet., *Hedwigia,* Vol. XXXV., p. 209.
1902. *Didymium excelsum* Jahn, *Ber. Deut. Bot. Ges.,* XX., p. 275.

Sporangia clustered or gregarious, discoidal and umbilicate below, or lobed or convolute, greyish white, stipitate; stipe pale yellow, tapering upwards, stuffed with lime crystals, expanding into the yellowish, discoidal, recurving columella; capillitium colorless, more or less branching; spores dark purple-brown, irregularly reticulate, 9–12 μ.

Differs from *D. squamulosum* in the reticulate epispore. Brazil.

19. Didymium leoninum *Berk. & Br.*

1873. *Didymium leoninum* Berk. & Br., *Jour. Linn. Soc.,* XIV., p. 83.
1876. *Lepidoderma tigrinum* Rost., *App. to Mon.,* p. 23.
1909. *Lepidodermopsis leoninus* v. Höhnel, *Sitz. K. Ak. Wiss. Wien, Math. Nat. Ks.,* CXVIII., 439.

Sporangia gregarious, subglobose, covered more or less completely with white or yellowish deposits of crystalline lime, stipitate; stipes short, orange or brown, containing lime, enlarged to form the globose orange columella and often connected at base by a venulose hypothallus; capillitium of slender threads, anastomosing, colorless at the tips; spores violet-grey, minutely warted, 7–9 μ.

Like *Lepidoderma tigrinum,* but has different calcic crystals.

Java and Ceylon.

3. Diderma *Persoon*

1794. *Diderma Persoon, Röm. N. Mag. Bot., I.,* p. 89.
1873. *Chondrioderma* Rost. *Versuch,* p. 13, *Mon.,* p. 167.
1894. *Chondrioderma* Rost., List., *Mycetozoa,* p. 75.
1899. *Diderma* Persoon, Macbr., *N. A. S.,* p. 92.

Sporangia plasmodiocarpous or distinct, sessile or stipitate; the peridium as a rule double, the outer wall generally calcareous with the lime granules globular, non-crystalline, the inner wall very delicate and often, in the mature fructification, remote from the outer; columella generally prominent.

The genus *Diderma* is usually easy of recognition, by reason of its double wall, the outer, crustaceous, usually calcareous, and its limits remain substantially as originally set by Persoon. His definition is as follows: —

"Peridium ut plurimum duplex; exterius fragile; interius pellucens, subdistans. Columella magna, subrotunda. Fila parca latentia." — *Syn. Meth. Fung.,* p. 168.

Rostafinski changed the name of the genus to *Chondrioderma* (*chondri,* cartilage), seemingly at De Bary's suggestion, and seems to have regarded Persoon's definition as applicable to those species only in which the wall is not only plainly double, but in which the two walls are as plainly remote from each other. More especially he esteemed a new generic name necessary, since he regarded several included species, as *D. spumarioides, D. michelii,* etc., monodermic.

Since it is doubtful whether any diderma is really monodermic, and since Persoon's definition in any case seems sufficiently elastic, we have seen no reason to discard the older name. Persoon's *Diderma* when established, *l. c.,* included *D. floriforme.* He made some confusion in his later work by admitting some physarums. This induced Schrader to throw all the didermas into his new genus, *Didymium.*

According to the nature of the sporangial wall, the species fall rather naturally into two sections: —

A. Outer sporangial wall distinctly calcareous, fragile; species generally sessile . . . . . *Diderma*
B. Outer sporangial wall cartilaginous, the inner less distinct, or concrete with the outer; species oftener stipitate . . . *Leangium*

A. Sub-Genus DIDERMA

1. Fructification wholly plasmodiocarpous . . . 1. *D. effusum*
2. Fructification of distinct sporangia.
   - *a.* Sporangia on a common hypothallus.
     - * Outer wall fragile, not widely remote from the inner 2. *D. spumarioides*
     - ** Inner wall lacking . . . . 3. *D. simplex*
     - *** Outer wall crustaceous, porcelain-like.
       - i. Spores 8–10 . . . 4. *D. globosum*
       - ii. Spores 12–15 . . . 5. *D. crustaceum*
     - **** Outer wall firm, not crustaceous . 6. *D. lyallii*
   - *b.* Sporangia isolated, or, at least, not on a common hypothallus, sessile.
     - * Outer wall porcellanous, roseate . 7. *D. testaceum*
     - ** Outer wall white . . . . 7. *D. niveum*
     - *** Outer wall ashen . . . . 9. *D. cinereum*
   - *c.* Sporangia stipitate . . . . 10. *D. hemisphericum*

B. Sub-Genus LEANGIUM

1. Sporangia generally sessile.
   - *a.* Inner peridium distinct.
     - * Membranous colorless, columella scant 11. *D. sauteri*
     - ** Colorless, columella prominent, red 12. *D. cor-rubrum*
     - *** Outer ochraceous, inner yellow . 13. *D. ochraceum*
   - *b.* Peridial layers inseparable.
     - * Peridium multifid; columella small or none 16. *D. trevelyani*
     - ** Peridium breaking into but few irregular lobes; columella prominent.
       - i. Peridium umber brown . 14. *D. roanense*
       - ii. Peridium ashen . . . 15. *D. radiatum*
       - iii. Peridium chocolate without, inside white 17. *D. asteroides*
2. Sporangia stipitate.
   - *a.* Peridium pallid, smooth . . . . 18. *D. floriforme*
   - *b.* Peridium white, rugulose . . . . 19. *D. rugosum*

1. DIDERMA EFFUSUM *(Schw.) Morgan.*

1831. *Physarum effusum* Schw., *N. A. F.*, p. 257.
1896. *Diderma effusum* (Schw.) Morg., *Jour. Cin. Soc.*, p. 71.
1899. *Diderma effusum* (Schw.) Morg., Macbr., *N. A. S.*, p. 94.
1899. *Diderma reticulatum* Rost., Macbr., *N. A. S.*, p. 95.
1911. *Diderma effusum* Morg., Lister, *Mycetozoa, 2nd ed.*, p. 102.

Fructification plasmodiocarpous, reticulate, creeping, applanate and generally widely effused, white; the peridium thin, cinereous, covered

by a delicate, white, calcareous crust; the columella simply the base of the plasmodiocarp, thin alutaceous; the capillitium pale, consisting of short threads somewhat branched toward their distal extremities; spores smooth, pale violaceous, 8–10 μ.

This is *Physarum effusum* Schw., *vid. N. A. F.,* No. 2297. It is reported by Morgan from Ohio, and we have one specimen from eastern Nebraska, so that it is probably of general distribution in the eastern United States.

This species was in the previous edition distinguished from the Rostafinskian *P. reticulatum* with spores a little smaller, 6–8 μ, and with a much stronger tendency to the formation of definite sporangia, elongate indeed and branching but often globose or depressed globose. This we may know as,

Var. RETICULATUM Rost.

1875. *Chondrioderma reticulatum* Rost., *Mon.,* p. 170.
1894. *Diderma reticulatum* (Rost.) Morg., *Jour. Cin. Soc.,* p. 71.

Sporangia gregarious, generally rounded, not much depressed, flat, sometimes, especially toward the margin of a colony, elongate, venulose or somewhat plasmodiocarpous, dull white, the inner peridium ashen or bluish, remote from the calcareous crust, which is extremely fragile, easily shelling off; columella indistinguishable from the base of the sporangium, thin, alutaceous; capillitium of short, generally colorless, delicate, sparingly branching or anastomosing threads perpendicular to the columella; spores black in mass, by transmitted light violet-tinted, smooth, 6–8 μ.

Perhaps our most common form. Found in fall on dead twigs, leaves, etc. Recognized by its rather large, white, depressed or flattened sporangia tending to form reticulations, and hence suggesting the name. The lines of fruiting tend to follow the venation of the supporting leaf; where the sporangium is round, the columella is a distinct rounded or cake-like body; where the fruit is venulose, the columella is less distinct.

By these rounded forms we pass easily, as by a gate, to *D. hemisphericum,* which, when wholly sessile, differs still in greater diameter of the sporangia and in having somewhat larger spores. Usually

in such case the compared colony will show somewhere a very short and stout but very real stipe supporting the discoid fruit.

Rostafinski divided the genus *Chondrioderma,* i. e. *Diderma,* into three sections: —

Monoderma to include those species in which the calcareous crust is less distinct or connate with the true peridium.

Diderma, in which the two structures were plainly separate.

Leangium, used as in the present work. In his first section Rostafinski placed *C. reticulatum* and *C. michelii;* in the second, *C. difforme* and *C. calcareum.*

Lister has examined Rostafinski's type of *C. reticulatum* and declares that it has the usual didermic characters. Hence there is no doubt that our small-spored American specimens are covered by Rostafinski's description, No. 72. On the other hand, Lister makes *C. difforme* (Pers.) Rost. a *Didymium,* by its crystalline coat. That species therefore is removed from consideration in this connection. *C. calcareum* remains as applicable to American forms having the spores 10–12 μ, but according to the author of the species the capillitium is abundant and definitive. Unhappily the type of *C. calcareum* is lost (Lister, *Mon.,* p. 95), so that there is no other means of verification than the description and Rostafinski's figure. Under these circumstances we consider the name *calcareum* inapplicable to any American forms we have so far seen. See next species. As to the American species which have been distributed as *C. calcareum* (Lk.) Rost., they are, so far as seen, referable to *D. reticulatum* (Rost.), Morg. Here also belongs No. 1217, Ellis, *N. A. F.*

New York, Pennsylvania, Ohio, Iowa, Nebraska. Probably to be found throughout the eastern United States.

2. Diderma spumarioides *Fries.*

1829. *Diderma spumarioides* Fries, *Syst. Myc.,* III., p. 104.
1833. *Physarum stromateum* Link., *Handb.,* III., p. 409.
1876. *Chondrioderma stromateum* (Lk.) Rost., *App.,* p. 18.

Sporangia sessile, crowded, spherical, or by mutual pressure irregular, white; the peridium plainly double, but the layers adhering, the outer more strongly calcareous, but very frail, almost farinaceous;

hypothallus more or less plainly in evidence, white or pale alutaceous; columella distinct, though often small, globose, yellowish; capillitium variable in quantity, sometimes abundant, brown, somewhat branching and anastomosing outwardly, the tips paler; spores minutely roughened, dark violaceous, about 10 μ.

This species has the outward seeming of a didymium, but is plainly different as that genus is here defined, since the calcareous crust, although inclined to be pulverulent, is made up of minute granules, not crystals, of lime. The hypothallus is sometimes hardly discoverable, anon well developed, out-spread, rugulose, far beyond the limits of the fructification. In his *Monograph,* p. 175, Rostafinski includes here *Physarum stromateum* Link. In the Appendix he is inclined to raise Link's form to the dignity of a distinct species, basing the diagnosis upon the superposition of the sporangia in certain cases, a feature entirely unknown to Link's description and of extremely uncertain value, since by their crowding the sporangia are liable always to be pushed above each other. We therefore regard *C. stromateum* (Link) Rost. as a synonym of the present species, as the description, Link, Handb., III., 409, indicates, so far as it goes.

3. Diderma simplex *(Schroet.) Lister.*

1885. *Chondrioderma simplex* Schroet., Krypt. Fl. Schles., III., 1, p. 123.
1911. *Diderma simplex* List., *Mycetozoa, 2nd ed.,* p. 107.

"Plasmodium bright yellowish brown." Sporangia gregarious, sessile, globose or depressed globose, .3–.5 mm., or anon plasmodiocarpous, brown or brick-red when fresh, becoming paler, ochraceous, etc.; hypothallus everywhere in evidence; columella ill-defined; capillitium scanty, the threads delicate, pale, branching as they join the peridial wall; spores dull violaceous, slightly roughened, 8–10 μ.

A rather crude, primitive representative of this beautiful genus. The inner peridium seems to be lacking, — a comfort to Rostafinski! Rare. Our best specimens are from New Jersey, by courtesy of Dr. C. L. Shear. These went to fruit on leaves and branches of *Vaccinium.* It seems to affect the heather of Europe, moorland, etc. I have also specimens from the herbarium of the lamented Dr. Rex. These are more plasmodiocarpous, but open beautifully by a median

fissure as in *Physarum sinuosum* Bull. In no American gathering that I have examined does the capillitium show calcareous thickenings as described by the British text.

4. DIDERMA GLOBOSUM *Persoon.*

PLATE VII., Figs. 5, 5 *a.*

1794. *Diderma globosum* Pers., *Röm. N. Mag. Bot.,* I., p. 89.
1875. *Chondrioderma globosum* (Pers.) Rost., *Mon.,* p. 180

Sporangia more or less closely gregarious, sessile, globose or by mutual pressure prismatic or polyhedral, white, the outer wall smooth, polished, crustaceous, fragile, far remote from the inner, which is thin, smooth, or rugulose, iridescent blue; hypothallus usually pronounced and spreading beyond the sporangia, sometimes scanty or lacking, columella variable, sometimes very small, inconspicuous, sometimes large, globose, ellipsoidal, even pedicellate; capillitium abundant, brown or purplish brown, branching and occasionally anastomosing to form a loosely constructed superficial net; spores globose, delicately spinulose, 8 μ.

This species seems rare in this country. We have specimens from Iowa. It is distinguished by small spores and generally snow-white color. Lister has thrown doubt upon Rostafinski's definition of this form — *Mycetozoa,* p. 78. Almost everything distributed in the United States under this name belongs in the next species. Reported also from Ohio, — *Morgan.* Washington. But: — it should be found in Europe, where first described!

There are two ways to meet the difficulty. In the first place it seems probable that a small-spored form really hides somewhere in Europe. The difference between the *Monograph* measurement and the size admitted for *D. crustaceum* Pk., evidently considered by Mr. Lister as type and so used in his illustration, Pl. 85, is too great to be esteemed merely an error. That added .3 (Rost.) indicates caution, the average of several measurements. Our *D. globosum* may represent what the *Monograph* describes.[1] In the second place we may as

[1] Dr. Cooke, who used the microscope, applied the *Monograph* description to British forms occurring on leaves; proceeded further and found the same situation in New York. Mr. Massee gives the species wide range with spores 8–10 μ; average 9 μ; only a fraction too large; evidently none 12–15 μ.

American students mistake larger and more globular forms of something else, of *D. spumarioides* Fr., whose spores are but little larger; or of *D. effusum* (Schw.) Morg., where the flattened plasmodiocarps anon splatter out to globose drops of polished whiteness, and whose spores are 8 μ. But even here the chances of error are small. In the species last named the columella or sporangial base is alutaceous, not white; in Fries' species, while the columella if present may be white, the peridial walls are different, difficult to distinguish.

For these reasons, *D. globosum* Pers. may stand, waiting further light from Europe.

5. Diderma crustaceum *Peck.*

Plate VII., Fig. 7

1871. *Diderma crustaceum* Peck, *Rep. N. Y. Mus.*, XXVI., p. 74.
1889. *Chondrioderma crustaceum* (Peck) Berl., *Sacc.*, VII., p. 373.

Plasmodium at first watery, colorless, becoming at length milky white; sporangia closely crowded or superimposed, in a cushion-like colony, creamy white, globose, imbedded in the substance of the hypothallus, the outer peridium smooth, delicate, crustaceous, fragile, remote from the blue iridescent inner membrane; hypothallus prominent; columella variable, generally present, globose; capillitium dark-colored, the threads branching and combining to form a loose net; spore-mass black, spores by transmitted light dark violaceous, delicately roughened, 12–15 μ.

Common. Readily to be distinguished from the preceding by the larger spores and more crowded habit. New England west to Nebraska.

The didermas are generally delicately beautiful. The outer wall in the present species is like finest unglazed china, softly smooth, and yet not polished, often absolutely white, with porcellanous fracture. An inter-parietal space separates the outer from the inner wall, so that the former may be broken, bit by bit, without in the least disturbing the underlying structure. The inner wall is ashen or gauzy iridescent green, sending back all colors in reflected light. The spores are violet, deeply so when fresh, the capillitium strong and likewise tinted; the columella passing down and blending with the

common snow-white hypothalline base. The distinct habits of the two species are represented in Figs. 5 and 7. In the one the distinct sporangia are associated but not crowded; in the other all are massed together in quite æthalioid fashion, forming circumambient, chalky masses of considerable size, 2 or 3 cm., overcrowded, superimposed, where the sporangia are regular in shape and size by reason of mutual pressure. The plasmodium develops in forests and orchards, among decaying leaves, but is inclined to rise as maturity draws near, to ascend some twig erect, or the stem of a living plant to the height of several inches where the sporangia at length appear "heaped and pent", an encircling sheath, conspicuous after the fashion of a spumaria for which it is indeed sometimes mistaken.

6. Diderma lyallii *(Massee) Macbr.*

Plate XVIII., Figs. 5 and 5 *a*

1892. *Chondrioderma lyallii* Massee, *Mon.*, p. 201.
1894. *Chondrioderma lyallii* Mass., List., *Mycetozoa*, p. 81.
1899. *Diderma lyallii* Mass., Macbr., *N. A. S.*, p. 99.
1911. *Diderma lyallii* List., sub-species, *Mycetozoa, 2nd ed.*, p. 105.

Sporangia obovate, more or less closely crowded, white, stipitate, about 1 mm. in diameter, the outer peridium firm, stout, encrusted, especially above, with granular masses of lime, the inner well developed, more or less cartilaginous, opaque, yellow or buff-colored; hypothallus well developed, venulose, white, passing up unchanged to form the short, stout stipe and lower outer peridium; columella prominent, half the height of the sporangium, brown; capillitium of short, brown threads, rigid, much branched, forming a net, widened irregularly and especially at the net-nodes; spore-mass black, spores by transmitted light bright brown, rough, 15–17 μ.

A very distinct species; large, fine, showy sporangia in more or less crowded clusters spring from a snow-white, common hypothallus. First reported from western Canada. Our first specimens were collected by the late Mr. Charles Irish, on the eastern slopes of the Sierras, in Nevada; now coming in abundantly from all the western mountains to the Pacific.

7. Diderma testaceum *(Schrad.) Pers.*

Plate VII., 4, 4 *a*, and 4 *b*.

1797. *Didymium testaceum* Schrad., *Nov. Gen. Plant.*, p. 25.
1801. *Diderma testaceum* Persoon, *Syn.*, p. 167.
1873. *Chondrioderma testaceum* (Schrad.) Rost., *Vers.*, p. 13.
1874. *Diderma mariae-wilsoni* Clinton, *Rep. N. Y. Mus.*, XXVI., p. 74.
1899. *Diderma testaceum* (Schrad.) Pers., Macbr., *N. A. S.*, p. 99.
1911. *Diderma testaceum* Pers., List., *Mycetozoa, 2nd ed.*, p. 106.

Sporangia gregarious, sessile, depressed-spherical or sometimes elongate, small, 1 mm. or less, rose-white, smooth, the outer peridium crustaceous, rather thick and persistent, polished, slightly raised above the inner, which is dull ashen and more or less wrinkled; hypothallus none; columella prominent, hemispherical in the typical rounded forms, slightly rough, reddish or reddish alutaceous; capillitium usually abundant, of slender, delicate pale or colorless threads, little branched, and smooth; spores violaceous-brown, minutely roughened, 8–9 μ.

A very beautiful species occurring at the same time as the preceding and in similar situations. All our specimens from the west are on dead leaves of oak; some eastern gatherings are on moss. Easily recognized when fresh by its delicate pink or roseate color; weathered specimens are white, and might be confused with forms of *D. reticulatum,* but the sporangia in the present species are less flattened and only rarely in special situations run off to linear or plasmodiocarpous shapes characteristic of *D. reticulatum.*

Not common, although widely distributed from east to west. New England, New York, New Jersey, South Carolina, Ohio, Illinois, Iowa, Nebraska, California (*Harkness*), Washington, Oregon.

8. Diderma niveum *(Rostafinski) Macbr.*

Plate XVIII., Fig. 11 and 11 *a*

1875. *Chondrioderma niveum* Rost., *Mon.*, p. 170.
1877. *Diderma albescens* Phillips, *Grev.*, V., p. 114.

Sporangia gregarious, scattered, or more often crowded, sessile, depressed-spherical, sometimes ellipsoidal or elongate, white, the outer peridium crustaceous, chalky, smooth and fragile, the inner distinct, delicate, ochraceous; hypothallus scant or none; columella well developed, globose or hemispherical, orange-tinted or ochraceous; capil-

litium abundant, made of threads of two sorts, some purplish or dusky, with pale extremities, uneven, others more delicate and colorless, and with wart-like thickenings, all sparingly branched; spores violet-brown, minutely roughened, 9–10 μ.

This species is not common. From Colorado we have fine specimens typical in every way. Specimens from Washington are flat so far as at present at hand; probably represent *D. deplanatum* (R.) List., which the last named author regards as varietal of the present species, entering it and *D. lyallii* as sub-species 2 and 1 respectively. *D. deplanatum* may perhaps be best so disposed of; but *D. lyallii* is distinguished at sight, as well as by microscopic characters, spores nearly twice as great, rougher and different in color.

9. Diderma cinereum *Morg.*

1894. *Diderma cinereum* Morg., *Myx. Mi. Val.*, p. 70.

Sporangia gregarious, more or less crowded or even confluent, subglobose, only slightly depressed, ashen white; the peridium not obviously double, very smooth and thin, rupturing irregularly; hypothallus an indistinct membrane or wholly wanting; columella large, globose or hemispheric, white, the surface granulose; capillitium of very slender colored threads, the extremities pellucid, more or less branched; spores violaceous, minutely warted, 9–11 μ.

Growing on old wood, leaves, etc. The sporangium .3–.5 mm., thin and smooth or rugulose. This elegant little species I know only from specimens received from Mr. Morgan. It seems to be closely related to *D. spumarioides,* from which it is distinguished by its color, darker, and its smoother, or less spinulose spores. The author compares the color and external appearance to that of *P. cinereum,* — *Jour. Cin. Soc.,* XVI., p. 154.

Ohio, Pennsylvania.

10. Diderma hemispericum *(Bull.) Horne.*

1791. *Reticularia hemispherica* Bull., *Cham. de Fr.*, I., p. 93.
1829. *Didymium hemisphericum* (Bull.) Fr., *Syst. Myc.*, III., p. 115.
1829. *Diderma hemisphericum* (Bull.) Horne., *Fl. Dan.*, XI., p. 18.
1832. *Didymium michelii* Lib., *Pl. Ard.*, No. 180.
1873. *Chondrioderma michelii* (Lib.) Rost., Fuckel, *Sym. Myc.*, p. 74.

Sporangia gregarious, orbicular, discoid, depressed above and often umbilicate below, stipitate or sometimes sessile, the outer peridium white, fragile, crustaceous, soon breaking about the margins, closely applied to the inner, which is delicate, cinereous, and ruptures irregularly; stipe about equal to the diameter of the sporangium, 1 mm., rather stout, calcareous but colored, brownish or alutaceous, more or less wrinkled longitudinally, the wrinkles when present forming veins on the lower surface of the sporangium; hypothallus small; columella not distinct from the thickened brownish or reddish base of the sporangium; capillitium of delicate threads, mostly simple and colorless, often scanty; spores pale violaceous, nearly smooth, 8–9 μ.

A very well marked species, easily recognized, at least when stipitate, by its remarkable discoid or lenticular sporangia. After the spore-dispersal, the stipes are long-persistent, surmounted by a peculiar disk representing the consolidated columella, lower sporangial wall, and expanded stem-top. Sessile specimens are like similar forms of *D. reticulatum,* but in all the gatherings before us the stipitate type is at hand to reveal the identity of the species.

Rostafinski's figures, 131, 146, 149, and 150, adapted from Corda, exaggerate the hypothallus, but otherwise leave nothing to be desired.

As to synonymy, Bulliard has plainly the priority. His figure, t. 446, Fig. 1, can refer to nothing else, especially reënforced as it is by Sowerby, *Eng. Fung.,* t. 12.

Rather rare on fallen stems of herbaceous plants, but widely distributed, New England to Oregon and Washington.

11. Diderma sauteri *(Rost.) Macbr.*

1875. *Chondrioderma sauteri* Rost., *Mon.,* p. 181.
1891. *Chondrioderma aculeatum* Rex, *Proc. Phil. Acad.,* p. 390.

Sporangia scattered, gregarious, sessile, lenticular or hemispherical, flattened above and sometimes concave or umbilicate below, dusky or yellowish white, the outer peridium papyraceous, thin, occasionally wrinkled, rupturing irregularly, remote from the inner, which is thin, delicate, semi-transparent, grayish, rarely iridescent; hypothallus none; columella irregular, sometimes small and hardly evident, rugose, with spine-like processes, the persisting bases of the capillitial

threads, reddish brown; capillitium scanty, white, or colorless, simple or sparingly branched; spores dark violaceous, spinulose, 12–13 μ.

This is *Chondrioderma aculeatum* Rex, *Proc. Acad. Nat. Sci. Phil.*, 1891, p. 390. After careful comparison of specimens and various descriptions, especially that of Rostafinski with the type specimens of Dr. Rex, I am constrained to concur with Lister in adopting Rostafinski's name. The sporangia in the type specimens (Rex) are on moss, borne at the extreme tips of acuminate or aculeate leaves, so that at first sight they appear stipitate.

Apparently rare. Maine, New York.

12. Diderma cor-rubrum *Macbr. n. s.*

Plate XVIII., Fig. 2

Sporangia gregarious clustered, small .5–.7 mm., sessile corrugate-plicate, especially above, snow-white, the outer peridium cartilaginous polished without and within, the inner delicate, evanescent; columella well developed, globose or clavate, anchored by several stout transverse trabeculæ to the peridial wall, papillate, deep-red as is the peridium especially below; capillitium very delicate, sparingly branching, colorless; spores verruculose, fuliginous tinged with red, about 12 μ.

This curious but elegant little species is represented by a single colony collected by Professor Morton Peck in Iowa. It resembles *D. sauteri* but is distinguished by the plicate white wall, the stout columella with its lateral extensions, as by the more delicate spores. On rotten wood.

13. Diderma ochraceum *Hoffm.*

1795. *Diderma ochraceum* Hoffm., *Deutsch. Fl. Tab.* 9, 2, b.
1911. *Diderma ochraceum* Hoffm., List., *Mycetozoa, 2nd ed.*, p. 109.

Sporangia gregarious or clustered, .7–1 mm., sessile, globose or sometimes plasmodiocarpous, ochraceous yellow; outer wall cartilaginous with yellow deposits of lime, the inner also yellow, adherent or free; columella not distinct; capillitium simple or branching, purple-brown, hyaline at base; spores spinulose, purplish-grey, 9–11 μ.

Mr. Lister reports this species from Massachusetts.

14. Diderma roanense *(Rex) Macbr.*

1893. *Chondrioderma roanense* Rex, *Proc. Phil. Acad.*, p. 368.

Sporangia scattered, discoidal, thin, flattened or slightly convex above, plane or plano-concave below, umber-brown, stipitate, the outer peridium smooth, brittle, rupturing irregularly, the basal fragments somewhat persistent, concrete with the inner peridium, which is pure white, except near the columella, and punctate; stipe short, variable, longitudinally ridged, jet-black; hypothallus none; columella flat, discoidal, pale ochraceous; capillitium sparse, white or colorless, composed of simple, rarely forked, sinuous threads occasionally joined by lateral branches; spores dark violaceous, distinctly warted, 12–14 μ.

This species is readily distinguished by its color. The sporangia, found on rotten wood, are large, 1 mm., brown, and have thick, persistent walls. Dr. Rex considered that the species differs from other related forms not only in color, but in the well-marked discoidal columella and the jet-black irregular stipe. It is perhaps most nearly related to the following species.

Tennessee.

15. Diderma radiatum *(Linn.) Morg.*

Plate XVIII., Fig. 8

1753. *Lycoperdon radiatum* Linn. (?) *Sp. Pl.*, 1654.
1797. *Didymium stellare* Schrad., *Nov. Gen. Pl.*, p. 21.
1801. *Diderma stellare* (Schrad.) Persoon, *Syn.*, p. 164.
1875. *Chondrioderma radiatum* (Linn.) Rost., *Mon.*, p. 182.
1894. *Diderma radiatum* (Linn.) Morg., *Jour. Cin. Soc.*, p. 66.
1899. *Diderma stellare* Schrad., Macbr., *N. A. S.*, p 104
1911. *Diderma radiatum* List., *Mycetozoa, 2nd ed.*, p. 112.

Sporangia scattered, depressed-globose, sometimes also flattened below, stipitate, smooth or slightly corrugate, ashen or brownish, about 1 mm. in diameter, the peridium dehiscing irregularly or somewhat radiately from above downwards, the segments reflexed, the inner layer not distinguishable, or inseparable; stipe short, stout, brownish, sometimes almost lacking; hypothallus not conspicuous, but sometimes sufficient to connect the bases of adjacent stipes; columella large, hemispherical or globose, pallid or yellowish; capillitium abundant, of slender generally simple, colored threads, paler at the furcate tips; spores dark violaceous, minutely roughened, 8–11 μ.

Rare on rotten logs in the forests; September. Easily recognized by the short-stiped, ashen sporangia which before dehiscence indicate by delicate tracings the lines which subsequent cleavage is to follow. In texture the peridium resembles that of *D. floriforme.*

Pennsylvania, Ohio, Iowa, Virginia, Colorado, Washington, Oregon; Europe generally.

The Linnæan description on which to base the specific name *D. radiatum* is wholly inadequate. It appears also by the testimony of Linné *fils,* that *L. radiatum* Linné is a lichen! and the name is so applied by Persoon. But in the Linnæan herbarium preserved at London, *teste* Lister, the original type of *Lycoperdon radiatum* L. may yet be seen! to the confusion of *fils,* Persoon, and other followers of Schrader all, and our stellar species becomes radiate now, let us hope for long!

16. Diderma trevelyani *(Grev.) Fr.*

1825. *Leangium trevelyani* Grev., *Scot., Cr. Fl.,* Tab. 132.
1829. *Diderma trevelyani* (Grev.) Fr., *Syst. Myc.,* III., p. 105.
1875. *Chondrioderma trevelyani* (Grev.) Rost., *Mon.,* p. 182.
1877. *Diderma geasteroides* Phill., *Grev.,* V., p. 113.
1877. *Diderma laciniatum* Phill., *Grev.,* V., p. 113.

Sporangia scattered, globose or nearly so, smooth or verruculose, reddish-brown or rufescent, sessile or short-stipitate, the outer peridium firm, splitting more or less regularly into unequal, revolute, petal-like lobes which are white within, the inner not distinguishable as such; stipe, when present, equal, furrowed, concolorous; columella small or none; capillitium abundant, the threads rather rigid, purple or purplish brown, branching and anastomosing, more or less beaded; spores dark, violaceous brown, spinulose, 10–13 μ.

In 1876, Harkness and Moore collected in the Sierra Nevada Mountains of California, forms of *Diderma* which are described by Phillips, *Grev.,* V., p. 113, as *D. geasteroides* and *D. laciniatum.* English authorities who have examined the material agree that the forms described constitute but a single species, and Lister makes them identical with *D. trevelyani* (Grev.) Fr. Rostafinski's figures, 161, 162, are a curious reproduction, evidently, of Fried. Nees von Esenbeck's, Plate IX., Fig. 4. Massee describes a columella; Lister says

there is none. What may occasion such divergence of statement none may say; such forms as come in so far from our western mountains have no columella.

17. DIDERMA ASTEROIDES *List.*

PLATE XVIII., Figs. 3, 3 *a*

1902. *Diderma asteroides* List., *Jour. Bot.*, XL, p. 209.
1911. *Diderma asteroides* List., *Mycetozoa, 2nd ed.*, p. 113.

Sporangia globose or ovoid-globose, the apex more or less acuminate, sessile, sometimes narrowed at the base to a short, thick stalk, brown or chocolate tinted, marked at the apex by radiant lines, and at length dehiscent by many reflexing lobes revealing the snow-white adherent inner peridium on the exposed or upper side; columella also white, globose or depressed-globose; capillitium generally colorless, somewhat branched, especially above; spores dark violaceous, verruculose, 10–12 μ.

Oregon, the Three Sisters Mountains; Colorado; California.

A very beautiful species, recognizable at sight; when unopened, by the peculiar chocolate brown, the sporangia smaller than in *D. radiatum*. When opened, the snow-white flower-like figure, flat against the substratum, is definitive. Very near number 16 preceding; the dehiscence more regular.

18. DIDERMA FLORIFORME *(Bull.) Pers.*

PLATE VIII., Figs. 1, 1 *a*, 1 *b*.

1791. *Sphaerocarpus floriformis* Bulliard, *Champ.*, p. 142, t. 371.
1794. *Diderma floriforme* (Bull.) Persoon, *Röm. N. Mag. Bot.*, p. 89.

Sporangia crowded, generally in dense colonies, globose, smooth, ochraceous-white, stipitate, the peridium thick, cartilaginous, splitting from above into several petal-like lobes, which become speedily reflexed exposing the swarthy spore-mass, the inner peridium not discoverable, inseparable; stipe concolorous, about equal to the sporangium; hypothallus, generally well developed, but thin, membranaceous, common to all the sporangia; columella prominent, globose or cylindric, often constricted below, and prolonged upward almost to the top of the spore-case; capillitium of slender, delicate, sparingly

branched threads; spores dark violaceous-brown, studded with scattered warts, 10–11 μ.

Not uncommon, especially on rotten oak logs. Easily recognized by the peculiar form of the fruit, spherical before dehiscence, floriform after. Unlike most species, this form often fruits in dark places, in the interior of a log, even in the ground.

New England, Ontario to Iowa and Nebraska, and south.

19. Diderma rugosum *(Rex) Macbr.*

Plate XVIII., Fig. 10.

1893. *Chondrioderma rugosum* Rex, *Proc. Phil. Acad.*, p. 369.

Sporangia gregarious, scattered, white or ashen, rugulose over the whole surface, the ridges marking the lines of subsequent rupture or dehiscence, the peridium thin papyraceous, stipitate; stipe well developed about equal to the sporangium, subulate, almost black; hypothallus none; columella distinct, generally white, sometimes small, globose, sometimes penetrating the sporangium, to one-half the height; capillitium white or colorless, the filaments freely forked and combined by lateral branches into a loose network attached to the columella and basal wall below and the upper sporangial wall above; spores violaceous-brown, warted, 8–10 μ.

This species is well designated *rugosum,* and is recognizable at sight by its wrinkled, areolate surface. Related to *D. radiatum* in the prefigured dehiscence, but otherwise very distinct. Liable to be overlooked as a prematurely dried physarum. Rare. Plasmodium gray.

North Carolina, Iowa.

4. Lepidoderma *DeBary*

1858. *Lepidoderma* DeBy., *MS.* Rost., *Versuch,* p. 13.

Sporangia stalked or sessile; peridium cartilaginous, adorned without with large calcareous scales, superficial or shut in lenticular cavities; capillitium non-calcareous.[1]

[1] If a sporangium of *L. tigrinum* be mounted in water and treated to weak solution of hydro-chloric acid we may easily discover that the crystals, which so wonderfully adorn the outer wall in this and other species, consist, in part

Key to Species of Lepidoderma

A. Sporangia stipitate, stipe brown . . . . . 1. *L. tigrinum*
B. Sporangia sessile, plasmodiocarpous, spores 10–12 μ 2. *L. carestianum*
C. Sporangia plasmodiocarpous, spores 8–10 μ . . . 3. *L. chailletii*

1. Lepidoderma tigrinum *(Schrad.) Rost.*

Plate XIV., Fig. 7.

1797. *Didymium tigrinum* Schrad., *Nov. Gen. Plantarum,* p. 22.
1873. *Lepidoderma tigrinum* (Schrad.) Rost., *Versuch,* p. 13.

Sporangia scattered, rather large, hemispherical-depressed, stipitate, umbilicate beneath, the peridium shining, olivaceous or purplish, tough, covered more or less abundantly with angular scales; the stipe stout, furrowed, dark brown, but containing calcareous deposits withal, tapering upward, and continued within the peridium as a pronounced more or less calcareous columella; hypothallus more or less prominent, yellowish or brownish; capillitium dark, purplish-brown, of sparingly branching threads radiating from the columella; spores dull purplish-brown, minutely roughened, 10–12 μ.

A singular species, rare, but easily recognized by its peculiar, placoid scales, large and firmly embedded in the peridial wall. The internal structure is essentially that of *Diderma* or *Didymium.* The species occurs in hilly or mountainous regions, on moss-covered logs. The plasmodium pale yellow, some part of it not infrequently remains as a venulose hypothallus connecting such sporangia as are near together.

New England to Washington and Oregon; Vancouver Island.

2. Lepidoderma carestianum (*Rabenh.*) *Rost.*

1862. *Reticularia carestiana* Rabenh., *MS. Fung. Eur. exsic.,* No. 436.
1875. *Lepidoderma carestianum* (Rabenh.) Rost., *Mon.,* p. 188.
1891. *Amaurochaete minor* Sacc. & Ell., *Mich.,* II., p. 566.

at least, of calcium carbonate. We may also discover that in the case before us the crystal or scale lies indeed enclosed in a filmy sac of organic origin, and that could we have seen the outer peridium as it came to form, we might probably have found it made up largely of an ectosarcous foam in whose cavities the excreted calcium found place for tabulate crystallization. In other species listed, conditions are different, and the crystals assume a different shape. The phrase "bicarbonate of lime" quoted in this connection in the former edition of this work from Mr. Massee's *Monograph,* etc., is not clear.

Fructification in the form of flat, pulvinate plasmodiocarps, or, anon, sporangiate, the sporangia sessile, sub-globose, ellipsoidal, elongate, irregular, confluent, yellowish-grey, the peridium covered more or less completely with dull white, crystals or crystal-like scales; columella, where visible, yellowish-brown, calcareous; capillitium, coarse, rigid, more or less branched and united, or colorless, delicate, forming a definite net; spores distinctly warted, purple 10–12 μ.

This is a most remarkable species. The sporangiate forms little resemble those distinctly plasmodiocarpal. In the former the calcic scales and crystals are distinct and quite as in *L. tigrinum;* in the latter they are cuboid, irregular. The wall of the peridium in the plasmodiocarps at hand is black, and the covering accordingly shows white; in the sporangial forms the wall is brown, and the scales have a yellow tinge as if tinged with iron. In the sporangial presentation the capillitium is intricate delicate; in the plasmodiocarp, rigid, dark-colored, etc. This looks like a didymium and in so far justifies the opinion of earlier students. Fries, of course, includes all these things with the didymiums, and *D. squamulosum* probably often sheltered them under extended wing.

Didymium granuliferum Phill., *Grev.,* V., p. 114, from California is by European authors referred here. The capillitium carries calcareous crystalline deposits in special vesicles and the spores show remarkable variation in unusual size — 15–30 μ.[1]

Should probably be entered *Lepidoderma granuliferum* (Phill.) Fr., spores 15–18 μ.

Utah,—Harkness.

3. Lepidoderma chailletii *Rost.*

Plate XVIII., Figs. 6, 6 *a*, 6 *b*.

Sporangia distinct, coalescent or plasmodiocarpous, large, when isolated 1–1.5 mm., dull drab in color, very sparsely sprinkled with white tetrahedral or irregular scales; the peridium thin, more or less translucent, rugulose, dull brown, persistent; columella none; capillitium abundant, under the lens purple-brown, sparingly branched,

[1] Doubtless immature; *v. Mitteil. Naturwiss. Gesell. Wintert.,* VI., p. 64, Lister quoted by Schinz.

even, stout, rigid, no calcareous deposits nor vesicles; spores 8–10 μ, minutely warted, fuliginous.

Yosemite Cañon, California, *Prof. B. Shimek.*

This is, no doubt, similar to *L. carestianum* but differs in the size and habit of the sporangia, and in the fact that the capillitium is uniform throughout, whatever the style of fructification, and in the size, color, and surface characters of the spore.

Evidently not *Didymium granuliferum* Phill. Both will, no doubt, be again collected, and we shall then have much needed light.

Nor is this quite Rostafinski's species as cited. The spores are much smaller; Rostafinski says 10–12 or more, and calls for a distinctly netted capillitium, the surface strongly marked by abundant calcareous crystals. Ours may be a different thing.

5. Colloderma *G. Lister*

1910. *Colloderma, Jour. of Botany,* XLVIII., p. 312.

Peridium double; the outer gelatinous, the inner membranaceous; capillitium intricate, limeless.

COLLODERMA OCULATUM *(Lipp.) G. Lister.*

1894. *Didymium oculatum* Lipp., *Verh. Zo-Bot. Ges. Wien,* XLIV., p. 74.
1910. *Colloderma oculatum* (Lipp.) G. List., *Jour. Bot.,* XLVIII., p. 312.

Sporangia gregarious, globose, or sub-globose, sessile or short-stipitate, olivaceous or purplish-brown, smooth and shining, the outer peridium gelatinous, thickened by moisture, hyaline; stipe dark brown; columella none; capillitium as in *Didymium* purplish-brown, colorless at the tips; spores spinulose, fuscous, about 12 μ.

New Hampshire, Europe.

Our specimens from the late Dr. W. G. Farlow who collected it in New Hampshire. Swollen by immersion in water the sporangia take on an eye-like appearance, oculate, etc.

EXTRA-LIMITAL

PHYSARINA *von Höhnel.*

1909. *Physarina* von Höhnel, *Akad. Wiss. Wien; Math-nat. KL.,* CXVIII., p. 431.

Sporangium wall rough with blunt spine-like processes, otherwise as *Diderma.*

One species, *op. cit.,* p. 432, *P. echinocephala* v. Höhn.

Java. Might as well be called *Diderma echinocephalum,* one would think. Structure is that of *Leangium.* The striking character is a surface modification of the outer peridium, according to the description.

Order II

STEMONITALES

Capillitium present, thread-like, arising in typical cases from a well-developed columella; spores in mass, black or violet-brown, more rarely ferruginous.

Key to the Families of Stemonitales

A. Fructification æthalioid, capillitium poorly defined; columella rudimentary or none . . . . . AMAUROCHÆTACEÆ

B. Fructification of distinct sporangia, capillitium well defined; the columella generally prominent, long and abundantly branched throughout p. 159 STEMONITACEÆ

C. Sporangia distinct; capillitium developed chiefly or only, from the summit of the columella . . . . p. 187 . LAMPRODERMACEÆ

A. AMAUROCHÆTACEÆ

Fructification æthalioid, an inch or two in diameter, in form varying with the habitat and place; capillitium dendroid, consisting of rather stout branches which rise irregularly more or less vertically from the hypothallus, branch repeatedly, often anastomose to form a network, especially toward the periphery; spores black.

A single genus —

1. Amaurochæte *Rostafinski*

1873. *Amaurochaete* Rost., *Versuch.,* p. 8.

The genus *Amaurochaete* as defined by Rostafinski and the genus *Reticularia* as represented by *R. lycoperdon* Bull. stand, the expression, perhaps, of not dissimilar histories. Whether in regressive or

progressive series, each to-day presents a case of arrested development. Each in æthalioid fructification, reveals a mass of involved individual (?) sporangia, so imperfectly developed that their outlines can be inferred rather than anywhere, with absolute definiteness, certainly ascertained. Perhaps, because similar sporangia in the group to which either belongs, do come under other circumstances, to more perfect individual form and function — perhaps for this reason we may look upon these æthalia as exhibiting a suspended performance; the sporangia have failed to go forward to what was evidently a possible, though apparently not an essential destiny in form and figure. For the care and dispersal of the spores, achievement must surely be somewhat impaired. Whatever the measure of such inefficiency, among the *Stemonitales Amaurochaete* shows the acme, as *Reticularia* among the brown-spored forms.

In *Amaurochaete* the individuality of anything like separate sporangia is less clear. The view afforded, however, by a good vertical section of a well-developed colony or cushion is interestingly arborescent. Ragged, dendroid stems arise, dissipated above into a network most intricate, a "pleached arbor" if you please. The resemblance of the overhead net to that presented by a stemonitis or comatricha is very striking.

Key to the Species of Amaurochæte

A.	Capillitium rigid, irregular spores rough . .	1. *A. fuliginosa*
B.	Capillitium soft, woolly, cincinnate, spores as in *A*	2. *A. tubulina*

1. AMAUROCHÆTE FULIGINOSA *(Sowerby) Macbr.*

PLATE V., Figs. 8, 8 *a*.

1803. *Lycoperdon fuliginosum* Sow., *Eng. Fung.*, t. 257.
1805. *Lycogala atrum*, Alb. & Schw., *Consp. Fung.*, p. 83.
1875. *Amaurochaete atra* (Alb. & Schw.) Rost., *Mon.*, p. 211.

Fructification aethalioid, varying in form and size, if on the upper side of the substratum, pulvinate, if below pendent and almost stipitate, covered with a delicate cortex, at first shining, soon dull, black, fragile, and early dissipated; hypothallus long-persisting, supporting the capillitium, which is extremely variable, irregular, and for its

perfection dependent upon the form assumed by the æthalium, and the conditions of weather, etc., under which it matures, sometimes, especially when prostrate, in a very much depressed æthalium, spreading into long fibrous threads, again under better conditions rising in columella-like forms, supporting a peripheral net; spores dark brown or black, irregularly globose, spinulose, 12.5–15 μ.

Common in Europe, and probably not uncommon in this country wherever pine forests occur. Specimens before us are from New England and New York, Ohio, Carolina, Colorado. Canada.

Sowerby, in his comment on plate 257, *Eng. Fungi,* says: "It appears to consist of branching threads affixed to the deal and holding a dense mass of sooty powder. Over the whole is a thin, deciduous pellicle." This description seems to be applicable to nothing else. The figure amounts to little. Fries recognizes the English description, as does Rostafinski, but both authors adopt the later name given by Albertini and Schweinitz, simply because of the excellent detailed description found in the *Conspectus.*

Amaurochæte tubulina *(Alb. & Schw.) Macbr.*

Plate XX., 6 and 6 *a.*

1805. *Stemonitis tubulina* (Alb. & Schw.), *Cons. Fung.,* p. 102.
1825. *Lachnobolus cribrosus* Fr., *Syst. Orb. Veg.,* p. 14.
1912. *Amaurochaete cribrosa* (Fr.) Macbr., *Com. in litt.* to Herbaria, Harvard, etc.[1]
1917. *Amaurochaete cribrosa* (Fr.) Sturg., G. Lister, *Jour. Bot.,* LVIII, p. 109.

Plasmodium at first transparent then white then rosy, ashen or grey finally deepening to jet-black; the æthalium even, thin, variable in extent from one to ten centimeters, covered by a distinct but thin transparent cortex, papillate, extended laterally but a short distance beyond the fructification, fragile, soon disappearing; hypothallus long-persistent, thin, silvery, supporting the capillitium as if by stipes, short slender columns, irregular plates, expansions, etc.; the capillitium an intricate network, very abundant, elastic, on fall of the peridium appearing like tiny tufts of wool, the meshes large, but formed as in *Stemonitis,* persistent, dull black; spores, under the lens, dull olivaceous black, minutely roughened, 12–14 μ.

[1] Vid. *Mycologia,* N. Y., Vol. IX., p. 328.

This species differs from the preceding, already well known, especially in the capillitial characters. In the older species the capillitial branches fray out, and are only sparingly united into a net extremely lax. In the present form the net is the thing, common to all sporangia. The total effect is to lend to the blown-out æthalium a woolly appearance, entirely unlike that of its congener under the same conditions. But until fructification is quite mature, the presence of the collaborating sporangia below is indicated, suggested, by the papillose upper surface.

The amaurochetes are remarkable in that they appear upon coniferous wood, logs or lumber, to all appearance undecayed. The species just described developed abundantly in August on the recently decorticated logs of *Pinus ponderosa,* on the southwestern slopes of Mt. Rainier, Washington. In logging operations in the locality referred to, the trees are felled often at considerable distance from the mill. They are not infrequently large, 75–120 cm. in diameter. The logs are dragged along the ground, the transportation facilitated by removal of the bark from the new fallen trunk. In a few weeks' time, affected by alternate rain and sun, the whole surface becomes marked with hundreds of minute, almost invisible cracks, and it is in the larger of these that the plasmodium of the present species has its habitat. Hardly any mycologic phenomenon is more surprising than to see plasmodia rising to fructification, scores at a time, upon a surface, new and white, showing otherwise no evidence of any decomposition. Doubtless the persisting cambium, the unused starches, sugars, the wood of the season yet unlignified, afford easily accessible nutrition.

When this form was first examined in the laboratory its distinctness was immediately seen. It was without doubt Fries' cribrose reticularia; nobody questions that. Under this name, citing Fries' description, specimens were sent out to herbaria as Harvard. Further study of the records, however, soon convinces one familiar with the ontogeny of the case that we are here face to face with the species, described by Alb. & Schw. in their fine *Conspectus.* Their account of the form, evidently often taken and now described with great care, is entirely clear when read in presence of the facts. It is here sub-

mitted, as less easy of access but essential, if the reader would appreciate the present disposal of the species.

"S. Tubulina NOBIS

"S. magna pulvinata subhemisphaerica, stylidiis gregariis circinantibus, capillitiis elongatis cylindraceis in massam pulveraceam fuscam connatis, apicibus obtusis, prominulis, lucidis nigris.

"The size indeed, the circumscribed form, the capillitiums conjoined into a single body — indue this (form) with an appearance peculiar to a degree; however, should anyone prefer to call it a very remarkable variety of the preceding (*S. fasciculata*), we shall not strenuously refuse. At first glance it looks like a tubulina. After the fashion of its kind, the beginning is soft and milky. The diameter generally an inch and a half to two inches, the height four to six lines; the form perfectly round, or more rarely somewhat oblong. The hypothallus, stout, pellucid silvery, betimes iridescent, when turned to the light, easily separable from the substratum, bears the columellae, dusky, thin, hair-like, aggregate and yet entirely free, and everywhere circinately convergent, depressed by the super-imposed burden, hence decumbent: . . . . the capillitium loosely interwoven, coalesces to a common mass whose smooth and shining surface shows above, regularly disposed minute papillae, the apices of individual sporangia.

"Far from infrequent, on decorticate pine, of *Lycogala atrum* a constant companion"!

It goes of course without saying, that for the authors quoted, *Lycogala atrum* is *Amaurochaete atra* Rost. *A. fuliginosa* (Sow.) of more recent students, described and perfectly figured in the volume cited.

It is surprising that they did not enter the present species also as a lycogala. But the stemonitis relationship this time impressed them rather than the æthalial; besides they were misled by the *S. fasciculata* of Gmelin and Persoon, a composite which the genius of Fries hardly availed to disentangle twenty-five years later.

The last named author, as we see, wrote first *Lachnobolus,* then *Reticularia.* He calls the interwoven capillitium — *lachne,* wool, a

"pilam tactu eximie elasticam," etc. He read the description in the *Conspectus,* but carried away the stemonitis suggestion dominant there, as we have seen, put *S. tubulina* A. & S. as an undeveloped phase of *S. fusca,* which, of course, it is not. It needed not the authority of Rostafinski, *Mon.,* p. 197, to assure us this. The earlier authors describe the species in course of development to complete maturity, and clinch the story by declaring the form a constant companion of the commonly recognized amaurochete, so fixing the relationship for us by habitat also.

These men made a mistake, of course, in placing their species among the stemonites at all. They did much better however than Fries who called it a reticularia. It was also a mistake to cite *S. fasciculata,* — the small fasciculate tufts of *S. fusca* and *S. axifera* offering by the aggregate habit only faint resemblance,—a possible refuge for those who would prefer another disposition of their species distinct (*aliena*) though it is.

Since Fries' day the species has been overlooked although the genus has received more than once attention. Zukal *Hedwigia,* XXXV., p. 335, describes *A. speciosa* as a new species. This Saccardo writes down, Syll. Fung., VII., p. 399, *S. tubulina* A. & S., admitting, however, at the same time, that as fine an authority as Raciborsky refuses to call Zukal's species either a stemonite or an amaurochete, thinks it deserving generic appellation of its own.

However, *A. speciosa* Zuk. need not here concern us. Neither in his description nor figures does Zukal at all approach the form we study. His species is not an amaurochete; the size of the spores suggest that, to say nothing of the capillitial structure.

In the same volume VII., the distinguished author introduces another amaurochete, *A. minor* Sacc. & Ellis, *Mich.* II., p. 566 This is American; sent from Utah by our famous pioneer collector Harkness. A specimen is before us: it is a lepidoderma! in shining, scaly armor dressed; vid. under *L. carestianum.*

Since the distribution of Washington material, as mentioned, our species reappears at various points in western Europe, points in England, etc., and will no doubt now share, hereafter as a century ago, the habitat so long conceded to the long familiar older type.

B. STEMONITACEÆ

Capillitium abundant, springing usually as dissipating branches from all parts of the columella; the sporangia generally definite and distinct, though sometimes closely placed and generally rising from a common hypothallus.

Key to the Genera of the Stemonitaceæ

A. Fructification æthalioid; capillitium charged with vesicles 1. *Brefeldia*
B. Sporangia distinct, or nearly so.
  a. Stipe and columella jet-black.
    1. Capillitium so united as to form a surface net 2. *Stemonitis*
    2. Capillitial branch-tips free . . . 3. *Comatricha*
  b. Stipe and columella whitish; calcareous . . 4. *Diachaea*

1. Brefeldia *Rostafinski*

1873. *Brefeldia* Rost., *Versuch,* p. 8.

Sporangia occupying in the æthalium several layers, those of the median, and especially of the lowest layers, furnished with columellæ which blend beneath; capillitium threads in the lowest layers arising from the columella, in the upper extending radiately between the individual sporangia, and united at the sporangial limits by means of rather large inflated sacs.

The genus *Brefeldia* is, like some others, difficult to dispose of in any scheme of classification where linear sequence must be followed. Rostafinski placed it in an order by itself. Its relationships are on the one hand with *Amaurochaete* and *Reticularia,* and on the other with the *Stemonitales,* though easily distinguished from either. It is intermediate to *Amaurochaete* and *Stemonitis,* and withal, as it appears to us, a little nearer the latter, as the limits of the individual sporangia are in *Brefeldia* pretty well defined.

1. Brefeldia maxima *(Fr.) Rost.*

Plate V., Figs. 7, 7 *a,* 7 *b,* and Plates XXI., XXII.

1825. *Reticularia maxima* Fries, *Syst. Orb. Veg.,* I., p. 147.
1875. *Brefeldia maxima* (Fr.) Rost., *Versuch.,* p. 8.

Æthalium large, four to twenty cm, papillate above, violet-black at first, then purple or purple-brown, developed upon a widespread,

silver-shining hypothallus; sporangia in favorable cases distinct, indicated above by the papillæ; columellæ obscure, black; capillitium abundant, the threads uniting by multifid ends to surround as with a net the peculiar vesicles; spore-mass dark violet-black, the individual spores paler by transmitted light, distinctly papillose, 12–15 μ.

A very remarkable species and one of the largest, rivalled by *Fuligo* only. To be compared with *Reticularia,* which it resembles somewhat externally, and with some of the larger specimens of *Enteridium.* The plasmodium at first white with a bluish tinge is developed abundantly in rotten wood, preferably a large oak stump, and changes color as maturity comes on, much in the fashion of *Stemonitis splendens,* leaving a widespread hypothallic film to extend far around the perfected fruit-mass. In well-matured æthalia, *"Jove favente,"* the sporangia stand out perfectly distinct, particularly above and around the margins. Closely and compactly crowded, they become prismatic by mutual pressure, and attain sometimes the height of half an inch or more. In the centre of the fructification, next the hypothallus, the sporangia are very imperfectly differentiated. Many are here horizontally placed, and perhaps supplied with an imperfectly formed peridium, — if so are to be interpreted the lowest parts of the capillitial structure, the long, branching, ribbon-like strands which lie along the hypothallus. Some of these branch repeatedly with flat anastomosing branchlets, ultimately fray out into lengthened threads, and perish after all the superstructure has been blown away. From every part of the structure so described, but more especially from the margins, are given off in profusion the strange cystiferous threads, so characteristic of this genus. These are exceeding delicate filaments, attached at one end, it may be, to a principal branch, at the other free or united to a second which again joins a third, and so looping and branching, dividing, they form a more or less extended network, a capillitium in which are entangled the myriad spores. Each filament bears at its middle point (or is it the meeting-point of two?) a peculiar plexus which embraces several large cysts or vesicles whose function or further homology does not readily appear.

From the base of the fructification rise also ascending branches which are black, terete, and not infrequently branched as if to form

the capillitium of a stemonitis. These ascending branches are in many cases, probably in all, real, though as yet imperfectly developed, columellæ. They rise, at least in many cases, directly from the hypothallus, each is central to an individual sporangium, rises to about two-thirds its height, but never attains the summit. The sporangia are so crowded that many are choked off below, never reach the top of the æthalium. In such cases the columella may cease at the sporangium-top. The columella bears cystiferous threads sparingly, if at all; nevertheless these abound in the peripheral portions of the sporangium all the way up, and are especially noticeable beyond the level of the top of the columella. Many are so arranged that the plexus with its vesicles occupies a place in the plane separating adjacent sporangia, suggesting the possibility that we have here to do with an imperfectly developed surface-net and peridium. In this view the cysts would represent the meeting-point of two opposite radial capillitial threads rather than the middle of one. This accords with Rostafinski's observations and drawings. The cysts, then, belong morphologically to the peridium or sporangium wall. It is a stemonitis whose sporangia have never been perfectly differentiated, a case of arrested development. See further under *Stemonitis confluens.*

Rostafinski really offers the first definitive description. Fries probably distinguished it, but his description would not indicate the fact except for the added note wherein appears the reason for discarding an apparently older name, viz., that given by Link. But neither Link nor Sowerby distinguished by description or figure *Brefeldia* from *Amaurochaete.*

Throughout the northern forest; Maine to Vancouver Island: not common.

2. Stemonitis *(Gleditsch) Rost.*

1753. *Stemonitis* Gleditsch, in part, *Meth. Fung.,* p. 140.
1873. *Stemonitis* (Gleditsch) Rost., *Versuch,* p. 7.

Sporangia distinct, though often closely aggregate, cylindric, stipitate; columella prominent; capillitium well developed by repeated lateral and apical branching of the columella, at length assuming at the surface the form of a distinct net which supports an evanescent peridium.

The genus is marked by its surface-net supported at the tips of the dichotomously branched divisions of the columella. Over the net is spread, theoretically at least, the peridial film supported by very short points projecting from the net, — the peridial processes; the peridium, however, is seldom seen; in some cases, certainly, is never developed. Rostafinski first defined the genus as employed by recent writers. Gleditsch simply renamed Micheli's *Clathroidastrum;* all writers subsequent included species of other genera.

The taxonomy of this genus is of the most difficult. Macroscopic, defining characters are few, and even these sometimes uncertain. Microscopic distinctions also tend to be illusive, variable in such fashion that often at the critical point the most exact description fails. All that may be done at present is to recognize two or three definite types and then cautiously differentiate among these with the light we have, until more general study of the group brings to service a wider range of observation with more comprehensive record on which judgment may better be sustained.

We have before us many and beautiful forms of this genus yet unstudied. Some of these doubtless have already found place in our growing taxonomic literature; some apparently undescribed; all to wait wider leisure or perhaps a younger hand.

The entire life-history of every form is none too much if we would set out with any hope of accuracy the genetic relationships for which taxonomy stands. Recently European students are making the color of the plasmodium a basis for species-discrimination, which is good so far. But plasmodic characters are at present unserviceable generally, for two reasons; they vary in the same species; and unfortunately, when most needed, they are unknown and inaccessible. The student is generally confronted by forms mature, the plasmodic stage already past.

Key to the Species of Stemonitis

A. Sporangia connately united.
- *a.* Spores verruculose . . . . . 1. *S. confluens*
- *b.* Spores reticulate . . . . . 2. *S. trechispora*

B. Sporangia at maturity distinct.
- *a.* Spore-mass grayish black.
  1. Larger, 8-12 mm. spores distinctly reticulate or warted, but sometimes nearly smooth . . . . 3. *S. fusca*

2. Spores reticulate and spinulose.
   i. Spores adherent, clustered . . . 4. *S. uvifera*
   ii. Sporangia very tall, 15–20 mm., rigid 5. *S. dictyospora*
   iii. Sporangia short, jet- or violet-black 6. *S. nigrescens*

b. Spore-mass rich brown.
1. Columella central.
   i. Sporangia shorter, 5–6 mm., spores banded 7. *S. virginiensis*
   ii. Sporangia 8–10 mm.; spores verruculose 8. *S. webberi*
   iii. Sporangia tall, 15–20 mm. or more 9. *S. splendens*
2. Columella eccentric, sporangium in cross-section, angular 10. *S. fenestrata*

c. Spore-mass ferruginous; sporangia in tufts.
1. Spores smooth or nearly so.
   i. Sporangia pale, small, 3–5 mm., crowded, stipe unpolished . . . . . 11. *S. smithii*
   ii. Sporangia ferruginous; columella regular 12. *S. axifera*
   iii. Sporangia ferruginous; columella proliferate just below the apex . . . 13. *S. flavogenita*
   iv. Sporangia, spore-mass, dusky-purplish or brown.
   * On dead wood.
   ° Scattered, apex blunt . 14. *S. pallida*
   °° Clustered, acuminate 15. *S. carolinensis*
   ** On living leaves, preferably, spore-mass brown 16. *S. herbatica*

1. Stemonitis confluens *Cooke & Ellis.*

Plate XI., Figs. 4, 4 *a*, 5.

1876. *Stemonitis confluens* Cke. & Ell., *Grev.*, V., p. 51.
1894. *Stemonitis splendens var. confluens* Lister, *Mycet.*, p. 112.
1899. *Stemonitis confluens* Cke. & Ell., Macbr., *N. A. S.*, p. 114.
1911. *Stemonitis confluens* Cke. & Ellis, List., *Mycet., 2nd ed.*, p. 147.

"Sporangia fasciculate, confluent on a persistent hypothallus, dark fuscous; peridia very fugacious; stipes united at the base, erect, furcate; spores large, brown, globose. On oak bark.

"The stems are branched in a furcate manner and confluent at the base, forming a compact tuft. The capillitium is membranaceous at the angles; spores very large compared with allied species, being 12 μ. The specimens were too fully matured for more satisfactory description."

Such is the original description of this unique and interesting species. The sporangia occur in close-set tufts or clusters, are distinct, separate at their tips and bases only; perhaps not always at base. The capillitium rises by branching from the columella, rather more prolific than usual, and combines to form a distinct superficial net of large even meshes. From the outer arcs of the bounding net spring rather long acute processes which should support the peridium. This, however, is altogether rudimentary. In most places there is no sign of peridium at all, but here and there between contiguous sporangia opposite processes unite and at their point of union a tiny circular disk of the peridial membrane appears. At intervals, therefore, over the entire sporangium are seen these small brown disks, each about equalling in diameter the size of the average mesh. At other points the sporangia do not seem at all coalescent, but where the opposing processes do meet the union is perfect and the little disk seen edgewise looks like some delicate counter strung upon a wire.

The interest attaching to this in view of what has been said about *Amaurochaete* and *Brefeldia* is obvious.

Under the lens the spores and capillitium are concolorous, dark fuscous, the spores distinctly verruculose, about 12.5 μ.

The original gathering here described was from New Jersey; twenty years later Mr. Ellis was so fortunate as to find again fine specimens all on oak bark. The sporangia are quite small, only 3 mm. high, when blown out concolorous with the habitat.

2. Stemonitis trechispora *(Berk.) Torr.*

Plate XX., Figs. 11, 11 *a*, 11 *b*, 11 *c*.

1909. *Stemonitis fusca* (Roth) Rost. var. *trechispora* (Berk.), *Fl. Myxom.*, Torrend, p. 141.

1911. *Stemonitis fusca* var. *trechispora* Torr., List., *Mycetozoa, 2nd ed.*, p. 144.

Fructification in form of aggregations of more or less coalescent, small, dark-brown or dull black, sessile sporangia; hypothallus continuous, well-developed; columella black, gently tapering to a point beneath the apex, the capillitial branches, irregular, few, but passing into an open rather evenly-meshed net, the mesh several times the

spore-diameter, free-ending branch-tips not lacking; the spores by transmitted light distinctly brown, the epispore a beautiful reticulation, a dozen or more cells to the hemisphere, 10–12 μ.

This is entered sometimes as a variety of *S. fusca* to which species relationship would seem remote. The differences lie in form, color and structure. The spores alone are distinctive; there are none such, so far, none just like them, elsewhere in the genus. Torrend and Lister both enter the form as varietal; why not set it out, and save questions? The habitat approaches that of *Amaurochaete,* but the sporangia are distinct.

For our specimens we are indebted to the kindness of Dr. Roland Thaxter. The specimens were taken in a half-dry marsh, near Cambridge.

Material from Toronto sent by Professor Faull is also provisionally here referred. The form has netted spores, but they are not quite the same. The structure besides is more that of an amaurochaete; it has the peculiar basal webs and band-like stipes at base, stipes that never rise from horizontal to perpendicular and characterize *Reticularia* and especially *Brefeldia* as well as the usual amaurochaete. See Plate XX., Figs. 9, 9*a*, 9*b*.

3. Stemonitis fusca *(Roth) Rost.*

Plate VI., Figs. 4, 4 *a*, 4 *b*

1787. *Stemonitis fusca* Roth, *Röm. Mag. Bot.,* I., p. 26.
1875. *Stemonitis fusca* (Roth) Rost., *Mon.,* p. 193.
1892. *Stemonitis fusca* Rost., Massee, *Mon.,* p. 72.
1895. *Stemonitis fusca* Roth, List., *Mycetozoa,* p. 110.
1899. *Stemonitis fusca* (Roth) Rost., Macbr., *N. A. S.,* p. 115.
1899. *Stemonitis maxima* Schw., Macbr., *N. A. S.,* p. 116.

Sporangia tufted, generally in small clusters 6–8 mm., the individual sporangia slender, cylindric, blue-black or fuscous, becoming pallid as the spores are lost, stipitate; stipe short, about one-fourth the total height, black, shining; hypothallus scanty, but common to all the sporangia; columella prominent, attaining almost the apex of the sporangium, freely branching to support the capillitial net; capillitium of slender dusky threads, which freely anastomose to form a dense interior network, and outwardly at length combine to form a

close-meshed net; spores pale, dusky violet, usually beautifully spinulose-reticulate, but sometimes warted or spinulose only, or nearly smooth, 7–7.5 μ.

As here set out the description is intended to include *S. maxima* Schw. of the former edition. Rostafinski, *Mon. l. c.*, describes *S. fusca* Roth. as having "spores smooth." Since most American gatherings have reticulated spores, and since Schweinitz described a black American species, his specific name seemed appropriate for all except smooth-spored forms.

In the meantime two things have happened; Mr. Lister has examined the specimens remaining in the Strasburg herbarium and finds them with reticulate spores. The statement quoted from the *Monograph* evidently does not apply to *all* of Rostafinski's material; but under the circumstances the name *fusca* may easily take the field, especially since another discovery makes for the same conclusion. The evidence is good that *S. maxima* Schw. was indeed the largest, i. e. perhaps, the *tallest* stemonitis he ever saw! probably, as his scanty herbarium-remnant shows, *S. fenestrata* Rex!

4. STEMONITIS UVIFERA *n. s.*

PLATE XX., Figs. 8, 8 *a*, 8 *b*, 8 *c*.

Sporangia tufted, generally in medium-sized clusters much as in *S. fusca*. The individual sporangium 7–9 mm. high, dark, slender, brown, becoming dull black or pallid as the spores are lost, stipitate, the stipe about one-fourth to one-third the total height, black polished shining; hypothallus distinct, common to all sporangia, purple-brown, shining; columella distinct, attaining almost the summit of the sporangium but inclined to waver a little at last, in other words, flexuose toward the top, freely branching, the branches rather stout, anastomosing to support the capillitial net; the meshes larger, several times the spore-diameter, the spores sooty-brown, distinctly warted or spinulescent, about 7–8 μ, clustered in groups of four or more.

Mt. Rainier, Washington,— 1914.

5. STEMONITIS DICTYOSPORA *Rost.*

1873. *Stemonitis dictyospora* Rost., *Mon.*, p. 195; *Myc. Fen.*, pp. 114, 122.
1879. *Stemonitis dictyospora* Rost., Mass., *Mon.*, p. 83(?).

1888. *Stemonitis dictyospora* Rost., *Sacc. Syl. Fung.,* Vol. VII., p. 397.
1893. *Stemonitis castillensis* Macbr., *Nat. Hist. Bull.,* Vol. 11, p. 381; Plate X., Figs. 5, 5 *a*, 5 *b*.

Sporangia crowded in colonies of unusual size, 4–8 cm., tall, rigid 18–25 mm., slender, erect, stipitate, black throughout; the columella prominent, reaching nearly to the apex, abundantly branched, the branches forming an intricate dark brown capillitium; the net large-meshed several times the spore-diameter; the spores reticulate, spinulose, clear violet, 7–8 μ.

We here recover as is believed one of Rostafinski's best-described species. Our material is from Nicaragua, by kindness of Professor Shimek. Its relationship is with *S. fusca* where Rostafinski placed it. The phrase describing spore-color is his.

6. Stemonitis nigrescens *Rex.*

1891. *Stemonitis nigrescens,* Rex, *Proc. Phil. Acad.,* p. 392.
1911. *Stemonitis fusca* Roth, Lister, *Mycetozoa, 2nd ed.,* p. 143.

Sporangia gregarious, upon a common hypothallus, erect, small, cylindric, stipitate; stipe black, extremely short, about half a millimetre; columella reaching the apex; capillitium violet-black, darker near the surface, forming a complete superficial net at the lower part of the sporangium only, elsewhere irregular or vanishing; spore-mass nearly black; single spores violet-black under the lens, the epispore spinulose and reticulate, about 8 μ.

The author of this species remarks: "This species is noteworthy for its comparatively short stipes, its very spinulose spores, and its black or nearly black color, the slight violet tint being only apparent on close inspection, especially in fresh moist specimens."

It is a small but very beautiful form, at first sight to be mistaken for a short *S. fusca,* though much more intensely black. The capillitium is concolorous, the inner network of rather few open meshes, the outer of large hexagonal openings, the arcuate threads of which are remarkable for the size, and especially the number, of the peridial processes, as many as five or six sometimes appearing along one side of a single mesh. The stipe is very short, and the columella runs as a straight, gradually diminishing axis to the very apex of the sporangium. Total height 3–5 mm.

The English *Monograph* includes this with *S. fusca;* but it seems quite distinct in size, habit, color, etc., and has been found in the mountainous regions of Virginia and North Carolina, as well as about Philadelphia.

7. STEMONITIS VIRGINIENSIS *Rex.*

1891. *Stemonitis virginiensis* Rex, *Proc. Phil. Acad.*, p. 391.
1899. *Stemonitis virginiensis* Rex, Macbr., *N. A. S.*, p. 130.
1911. *Comatricha typhoides* Rost., List., *Mycetozoa, 2nd ed.*, p. 158.

Sporangia erect, gregarious, from a common hypothallus, generally clustered, cylindric or elongate-ovate, stipitate; stipe black, shining; columella reaching the apex, where it blends with the capillitium; capillitium delicate, the meshes of the net small, scarcely greater than the diameter of the spores; spore-mass umber brown; epispores reticulated, with ten or twelve meshes to the hemisphere, 5–7 μ.

This is a beautiful, and, as it seems to us, a very distinct, species. The markings on the epispore are sufficient to identify it. These are conspicuously banded somewhat as the spores of *Trichia favoginea,* for example. In habit, size of the sporangia, and capillitial branching, this species recalls *Comatricha typhoides* (Bull.) Rost. All the sporangia examined are, however, plainly stemonitis in type, possessing the characteristic superficial net.

Until further light this may stand as offered in the first edition. Miss Lister prefers to enter it, banded spores and all, with the comatrichas, on account of color, size and occasional default (?) of surface net.

Virginia, *Dr. Rex.*

8. STEMONITIS WEBBERI *Rex.*

PLATE XI., Figs. 6, 7, 8.

1891. *Stemonitis webberi* Rex, *Proc. Phil. Acad.*, p. 390.

Sporangia clustered, usually in small tufts 1 cm. wide, rusty brown in color, 8–10 mm., including the stipe, which is jet black, shining, and much expanded at the base; hypothallus continuous, well-developed, a thin, transparent pellicle; columella black, tapering upward, giving off at intervals the capillitial branches, and becoming dissipated

just below the obtuse apex; inner capillitial network very open, the branches far apart, anastomosing but a few times before breaking into the surface net to form large, irregular meshes, 50–125 μ; spores minutely roughened, fuscous, 8–9 μ.

These three forms, 8, 9, 10, are sometimes entered as varieties of a single species. Dr. Rex himself was inclined to take that view. There is no doubt of close similarity; it is a question of clearness in our dealing with the subject.

All three forms occur abundantly in the Mississippi Valley, but are generally, — always, as it seems to the writer, — distinguishable by the hand-lens. If we take No. 9 as type, 10 has an eccentric columella; 8 is shorter, about 1 cm., of a different tint, Dr. Rex even says "spores ferruginous in mass". To the west and southwest, the capillitium becomes coarser, more decidedly brown. In short, however similar in presentation the phases may sometimes appear, it would seem that each at its best is distinct enough for immediate recognition.

West of the Mississippi River chiefly: Iowa, South Dakota, Nebraska, Kansas, Oklahoma, New Mexico, etc.

9. Stemonitis splendens *Rost.*

Plate VI., Figs. *6, 6 a, 6 c, 7, 7 a.*

1875. *Stemonitis splendens* Rost., *Mon.*, p. 195.
1880. *Stemonitis morgani* Peck, *Bot. Gaz.*, V., p. 33.
1893. *Stemonitis splendens* Rost., Macbr., *Bull. Lab. Nat. Hist.*, Vol. II, p. 381.
1894. *Stemonitis splendens* Rost., List., *Mycetozoa*, p. 112, in part.
1899. *Stemonitis morgani* Peck, Macbr., *N. A. S.*, p. 118.
1911. *Stemonitis splendens* Rost., List., *Mycetozoa, 2nd ed.*, p. 145.

Sporangia clustered irregularly, sometimes forming patches 6–10 centimetres or more in extent, rich purple-brown in mass, cylindric, long, 15–18 mm., stipitate; stipe black, polished, shining, rising from a common hypothallus, which extends as a thin silvery film beneath the entire colony, but does not usually transcend its limits; columella black, percurrent, sparingly branched; capillitium of fuscous threads, within forming a network very open, the branches scarcely anastomosing until they reach the surface where they form the usual net of

small meshes, pretty uniform in size, and presenting very few small, inconspicuous peridial processes; spores brown, very minutely warted, about 8 μ.

This elegant species occurs not rarely on rotten wood, usually in protected situations, although sometimes on the exposed surfaces of its habitat. The sporangia attain with us unusual height, sometimes 2 cm.; plasmodia, 6–8 cm., in diameter. The clear brown tufts appear in the autumn, marvels of graceful elegance and beauty; at sight easily recognizable by the large size and rich color. In Iowa it is almost universally present on fallen stems of *Acer saccharinum* Linn., and it appears to be widely distributed, by far the most beautiful of all this beautiful series.

New England to Iowa, South Dakota, Washington, and British Columbia. Professor Shimek brings a *dusky* phase from Nicaragua! — the type?

The plasmodium is white on maple stems, more creamy on stems of linden, on which wood it is more rarely found: occasionally on ash-stumps; even on the fallen bark of trees preferred.

In 1875 in his famous *Monograph,* Rostafinski set out three species with "dusky violet spores". These are his Nos. 94, 95 and 96.

The first one of these he calls *S. fusca,* "spore-mass, etc., violet-black, individual spore clear violet, smooth, 7–9 μ."

The second species he writes down *S. dictyospora,* "hypothallus, stalk, columella, capillitium and spore-mass, violet-black, spore netted and fringed, clear-violet, 7–9 μ."

The third species is *S. splendens,* "hypothallus stalk, columella and spore-mass violet-black, spore smooth, clear-violet, 7–8 μ."

It will be observed that in color down to color of the spore by transmitted light, the three species are exactly the same; constitute a suite, so to say. It has since turned out, as noted under our No. 3, that the spores of *S. fusca* are netted. Error in description here is not surprising; the reticulations are sometimes faint. In *S. dictyospora* they are admittedly strong, and the inference was that the *'gladkie'* spores of the third species might be netted also. This is no criticism: lenses were fifty years since not nearly so good for such discoveries as the oil-immersion is now.

However; Rostafinski made his specific diagnosis turn largely upon the mesh-width in the superficial net. This comes out in the *'opis'* following the description, and upon *this* the European decision in Rostafinski's favor as against *S. morgani* largely turns. Tropical gatherings are probably always darker, and evidently from such, from the north coast of South America, the original description was drawn. Specimens before us from the same latitude are dusky indeed; no clear brown at all, but purplish withal.

For the sake of harmony we may therefore now substitute the earlier name "with reservations"! but our description remains as before, presenting the really splendid, shining things that adorn our northern fields. Dr. Rostafinski called the large open meshes of the net *'oka'*, eyes; *lumina* let us say! quite uniform they are in 9 and 10, much less so in 8.

10. Stemonitis fenestrata *Rex.*

1890. *Stemonitis splendens* R. *f. fenestrata* Rex, *Proc. Phil. Acad.*, p. 36.

Sporangia aggregated, in tufts 2 cm. or more in diameter, rich purple brown, on a common hypothallus, more or less erect, stipitate, tall, about 2 cm., slender, triangular in section; stipe black, about one-third the total height, passing into a slender columella which is lateral in position, not central, but little branched, continued almost to the apex; the capillitium consisting almost entirely of the peripheral net, which presents meshes of unusual uniformity of size and shape; spores in mass brown, colorless by transmitted light, nearly smooth, 6–7.5 μ.

The remarkable shape of the sporangium and the peculiar regularity of the surface net, the lateral columella, all combine here to warrant the erection of a distinct species. Dr. Rex referred this to *S. bäuerlinii* Mass. At that time he had not the author's description, and had seen only a very poor fragment received with notes in a letter. Mr. Massee's description makes it immediately evident that whatever other affiliations *S. bäuerlinii* may have, by description it has at least none with *S. fenestrata* nor with our northern form of *S. splendens.* Massee's species is described as having the "mass of spores black", the capillitium with "branches springing from the col-

umella; the main branches more and more numerous, thicker and irregular towards the apex of the sporangium, and often form irregular flattened expansions": — etc. This suggests some form of *S. dictyospora* Rost.: see under our No. 5. Possibly for such reasons Lister referred it to *S. splendens* Rost., which as we have just seen, was undoubtedly regarded by the author as a form of the *fuscous* group.

The long, slender, simple columella is not only lateral, but occupies indeed the sharp vertical angle of the triangular, prismatic sporangium. Furthermore, the sporangium is at maturity strangely twisted, so that the columella in its ascent accomplishes one or more spiral turns. In forms collected by Dr. Rex, which seemed to him most nearly to agree with Massee's species, the inner capillitium is somewhat abundant, but the character of the columella just the same.

Pennsylvania, Ohio, Kansas, Colorado, Iowa; India!

11. Stemonitis smithii *Macbr.*

1893. *Stemonitis smithii* Macbr., *Bull. Lab. Nat. Hist. Ia.,* II., p. 381.
1894. *Stemonitis microspora* List., Morg., *Jour. Cin. Soc.,* p. 54.
1911. *Stemonitis ferruginea* var. *smithii* Lister, *Mycetozoa, 2nd ed.,* p. 150.

Sporangia in small clusters, close-packed and erect, not spreading, bright ferruginous prior to spore dispersal, cylindric, stipitate, of varying height; stipe jet-black, shining, about one-third the total height; hypothallus generally well developed; columella black, gradually tapering, at length dissolving in capillitial threads and net some distance below the diminished plumose apex; capillitium of fuscous threads, the inner network of abundant, sparingly united branches uniformly thickened, the surface net very delicate, composed of small, regular, polygonal meshes, the peridial processes few; spore-mass bright ferruginous, spores by transmitted light pale, almost colorless, smooth, 4–5 μ.

The species as thus constituted includes forms varying in size from 2.5–3 mm. only. The common form heretofore known everywhere in America as *S. ferruginea* is from 10–15 mm. high. The *type* to which the specific name *S. smithii* was originally applied is 2.5 mm. high and rejoices in smooth, almost colorless spores, 4–5 μ.

The plasmodium in the case of the species now considered is as

concerns the *type,* of course, unknown. In one or two gatherings referred here the color of the plasmodium was noted greenish-yellow. This has the look of *S. flavogenita;* but small spores and delicate make-up take it the other way. Miss Lister makes it varietal to No. 12, next following.

12. Stemonitis axifera *(Bull.) Macbr.*

Plate VI., 5, 5 *a,* and 5 *b.*

1791. *Trichia axifera ferruginea* Bull., *Champ. de la Fr.,* p. 118, tab. 477.
1818. *Stemonitis ferruginea* Ehr., *Syl. Myc. Berol.,* p. 20; et auct. Europ. ex parte; Americ., non.
1894. *Stemonitis ferruginea* Ehr., List., *Mycetozoa,* p. 115, in part.
1899. *Stemonitis axifera* (Bull.) Macbr., *N. A. S.,* p. 120, in part.
1911. *Stemonitis ferruginea* Ehr., Lister, *Mycetozoa, 2nd ed.*

Sporangia terete, acuminate, fasciculate small in dense clusters, distinctly ferruginous in color, stipitate, from 10–15 mm. in height; the stipe black one-third to one-half the total height, not shining or polished; columella evenly branching, dissipated before reaching the acuminate apex; capillitium-branches clear brown anastomosing and dividing more or less to bear the superficial fine-meshed net; spores pallid, faintly ferruginous, smooth or nearly so, 5–6 μ.

This would seem to be the common *ferruginous* species of the world. Doubtless Micheli had the thing before him when he drew Tab. 94, *clathroidastrum,* Hoffman and Jacquin seem to have recognized the form. To be sure, under the present plasmodic limitations we cannot be quite certain about these references. Not until 1791 does anyone write down a particular species as marked by a white plasmodium, and distinguish it from other similar fructifications having similar origin. Bulliard, *l. c.,* does this, discriminating between *T. axifera ferruginea* and *C. typhoides;* see under the last-named species. Youthful Ehrenberg, in his doctor's thesis, nearly thirty years later, draws a similar parallel but ignores the great French author, writing *S. ferruginea* Ehr. as though the thing had never been seen before! By this name it has been called until very lately; Fries accepting it, but noting that the plasmodium, for him at least, was *yellow!*

In 1904 Dr. E. Jahn, following Fries' suggestion, established the fact that Ehrenberg's white-plasmodic species had small spores, that

Fries had in mind a form with larger spores, having indeed yellow plasmodium; but see number 13 below.

It is for the present assumed that the plasmodium of our American *S. axifera* is white. So far, there are few or no observations which establish the fact. The color, the small smooth spores, the fine-meshed capillitial net and the general dimensions determine the reference.

13. STEMONITIS FLAVOGENITA *Jahn.*

PLATE XX., Figs. 10, 10 *a*, 10 *b*.

1829. *Stemonitis ferruginea* Ehr., Fries, *Myc.* III., p. 158, Syn. excl.
1899. *Stemonitis axifera* (Bull.) Macbr., *N. A. S.*, p. 120, in part.
1904. *Stemonitis flavogenita* Jahn, *Abh. Bot. Ver. Brandenb.*, XLV, p. 265.
1911. *Stemonitis flavogenita* Jahn, List., *Mycetozoa, 2nd ed.*, p. 149.

Sporangia cylindric, obtuse, closely fasciculate, "cinnamon brown," stipitate, 5–7 μ; stipe short, black, columella ceasing abruptly below the apex; capillitium a loose net-work with many broad expansions; the peridial net very delicate, the meshes small but uneven, 6–15 μ, with many projecting points; spores pale ferruginous, verruculose, 7–9 μ.

This is *S. ferruginea* Ehr. of Fries with its plasmodium yellow. Fries says "flavicat," *becomes* yellow, if one may follow the analogy of corresponding Latin verbs of color, so that the record of color-changes in the present species is yet to be recorded.

Until further experience may advise to the contrary, we may assume that all stemonites cinnamon-brown in color, with widened columella-tip, and pale yellowish spores 7–9 μ in diameter, have at some time in their history a yellow plasmodium, and accordingly represent in America the new-found species.

The larger spores, and, the strange proliferate development of the columella-tip, to which Miss Lister has happily called attention, constitute the essential diagnostic features here.

Our only specimens so far are from Oregon.

14. STEMONITIS PALLIDA *Wingate.*

PLATE XIII., Fig. 3

1897. *Stemonitis pallida* Wing., *N. A. F.*, Ell. and Ev., No. 3498.
1899. *Stemonitis pallida* Wing., Macbr., *N. A. S.*, p. 123.
1911. *Stemonitis pallida* Wing., List., *Mycetozoa, 2nd ed.*, p. 149.

Sporangia gregarious, or somewhat clustered, erect, cylindric obtuse, short, blackish brown, rubescent, becoming pallid, stipitate; stipe short, black, polished, rising from a thin, brown, or iridescent hypothallus; columella percurrent, ceasing abruptly at the apex; capillitium filling the interior with abundant branches which form at the surface a close-meshed net, little developed above, making the apex very blunt; spores in mass, dark brown, by transmitted light dusky, nearly smooth, 7.5 μ.

This species is well recognized at sight, among the fuscous forms, by its scattered, erect habit. In color it is not unlike *S. fusca,* but has an added reddish tinge. In form it is peculiar by virtue of the blunt rounded apex which seems to be a constant character. The spores under moderate lens are perfectly smooth, under the 1-12 they present very delicate low scattered papillæ.

Rare; eastern part of United States.

15. Stemonitis carolinensis *Macbr.*

Plate XIII., Fig. 5.

1894. *Stemonitis tenerrima* Berk. & C., Morg., *Jour. Cin. Soc.,* p. 53.
1899. *Stemonitis carolinensis* Macbr., *nom. nov., N. A. S.,* p. 152.
1911. *Stemonitis pallida* Wing., Lister, *Mycetozoa, 2nd ed.,* p. 149.

Sporangia tufted in scattered clusters, small, slender, cylindric but tapering from the apex, at first ferruginous then ashen or purplish, stipitate; the stipe short, black and shining, one-fourth the total height or less, even; hypothallus well developed, black or very dark brown; columella black, gradually diminishing, at length dissipated some distance below the clavate or acuminate apex of the sporangium; capillitium dense, the inner of many, scarcely expanded, pallid, freely anastomosing branches, the outer a net of very small meshes, often less than the spores, 3–15 μ, peridial processes imperceptible; spore-mass pale ferruginous, spores by transmitted light pale violaceous brown, smooth, 6–7 μ.

Very closely related to the preceding, but recognizable by its proportionately much more slender, taller, acuminate sporangia, paler, and denser capillitium and the remarkably close-meshed net.

Not uncommon south: Kentucky, Alabama.

16. STEMONITIS HERBATICA *Pk.*

PLATE XVI., Figs. 14, 14 *a*, 14 *b*

1874. *Stemonitis herbatica* Peck, *Rep. N. Y. Mus.*, XXVI., p. 75.
1899. *Stemonitis axifera* (Bull.) Macbr., *N. A. S.*, p. 120, in part.
1911. *Stemonitis herbatica* Pk., Lister, *Mycetozoa*, p. 148.

Sporangia clustered, in scattered tufts, cylindric, obtuse, pallid ferruginous, stipitate or sometimes nearly sessile; stipe fuscous or jet-black, only slightly expanded below, much shorter than the columella; hypothallus scanty or none; columella lessening upward, sometimes attaining the apex of the sporangium, sometimes dissolved in capillitial threads some distance below; capillitium of rich brown threads forming the usual inner network of medium density, with many wide expanded nodes, the surface net made up of delicate, almost colorless threads surrounding small polygonal meshes; spore-mass ferruginous, spores by transmitted light very pale, brownish, minutely warted, 7–9 μ.

The plasmodium of this species is variously cited from white to yellow. Probably each report is true, dependent on the relative time of the observation.

The low tufts of brown sporangia with short black stipes, borne often as Dr. Peck found them, assembled on living leaves, distinguish this little species. In the former edition this form was tentatively enrolled under *S. axifera* (Bull.); but see further under that species.

Probably widely distributed, but confused with short forms of other species; sometimes also on rotten wood or other substratum; so reported.

New York to Iowa; Washington and Oregon. Reported also from Europe.

3. Comatricha *(Preuss) Rost.*

1851. *Comatricha* Preuss, *Linnaea*, XXIV., p. 140.
1873. *Comatricha* Rostafinski, *Versuch*, p. 7.

Sporangia cylindric or globose, stipitate; stipe prolonged upward to form a more or less extended and tapering columella bearing branches on every side, which by repeated divisions and reunions form the capillitium; ultimate branch-tips free, not supporting a surface

net parallel to the peridial wall; peridium evanescent, perhaps sometimes not developed at all.

The genus *Comatricha* was set off from *Stemonitis* by the joint effort of Preuss (1851) and Rostafinski (1873–5). Preuss included in his genus, *Comatricha,* alien forms, and besides failed to give an accurate definition; included, however, in his list some species which have since been known by his generic name.

The distinction between the two genera is almost an artificial one, and species are sometimes arbitrarily assigned to one genus or the other. The diagnosis in any case turns upon the presence or absence of a surface net, formed, in *Stemonitis,* by the anastomosing of the ultimate divisions of the capillitial branches. In *Comatricha* the anastomosing is general, from the columella out, and is not specialized at the surface.

Recent attempts to reunite the genera here compared seem to result in no apparent advantage. The genera come very near together, but their separation along the line suggested by Rostafinski remains convenient.

Key to the Species of Comatricha

A. Sporangia closely clustered.
  a. Obovate or short cylindric.
    1. Spores verruculose . . . . 1. *C. caespitosa*
    2. Spores reticulate . . . . . 2. *C. cylindrica*
  b. Elongate, reddish-brown, tufts extended . . 3. *C. flaccida*

B. Sporangia scattered more or less widely.
  a. Capillitium lax, open.
    i. Sporangia long, 10–12 mm. . . . 4. *C. longa*
    ii. Sporangia shorter, capillitium irregular 5. *C. irregularis*
  b. Capillitium dense.
    i. Sporangia large, to 10 mm., spore-mass black 7. *C. suksdorfii*
    ii. Sporangia smaller — 6 mm.
      * Spore-mass brown, spherical, conoidal, etc., generally with more or less lengthened stipe . 8. *C. nigra*
      ** Spore-mass violaceous or purplish 9. *C. aequalis*
    iii. Sporangia ovate or cylindric, minute, to 3.5 mm.
      * Cylindric, spore with few, scattered warts 10. *C. typhoides*
      ** Smaller, capillitium irregular, loose 6. *C. laxa*
      *** Total height to 2 mm. or much less.
        † Columella digitately divided 11. *C. elegans*

†† Columella lamprodermoid, and on leaves
12. *C. rubens*
††† Columella stemonitoid
13. *C. pulchella*
†††† Columella furcate at tip 14. *C. ellisii*
††††† Columella almost percurrent.
15. *C. subcaespitosa*

1. COMATRICHA CÆSPITOSA *Sturgis.*

PLATE XI., Figs. 12, 13, 14.

1893. *Comatricha caespitosa* Sturg., *Bot. Gaz.,* XVIII., p. 186.
1894. *Diachaea thomasii* Rex, var., List., *Mycetozoa,* p. 92.
1899. *Comatricha caespitosa* Sturg., Macbr., *N. A. S.,* p. 124.
1911. *Diachaea caespitosa* Lister, *Mycetozoa, 2nd ed.,* p. 121.

Sporangia densely crowded or cespitose, sub-sessile or short stipitate, clavate, 1–1.5 mm. high, the peridium gray, iridescent with blue tints, comparatively permanent but finally disappearing; columella attaining two-thirds to three-fourths the height of the sporangium, giving rise throughout its length to the dense blackish capillitium; hypothallus delicate, inconspicuous; capillitium, the main branches thick at the point of origin, frequently anastomosing, and becoming gradually thinner toward the surface of the sporangium, the tips pointed, free, forming the network; spores blackish-violet in mass, by transmitted light pale brownish-violet, rough, 9.5–13 μ.

A very distinct and curious species. The sporangia are densely crowded, though by the nature of habitat somewhat tufted. The shape of the individual sporangium is quite uniformly clavate or obovate, decidedly truncate above. The spores are uniformly verruculose and plainly unequal.

This species, as indicated, was by its author described as a comatricha. To transfer it to another genus seems idle, especially when long established generic boundaries must be seriously disturbed expressly to admit the new arrival.

New England, North Carolina, on moss and lichens. — *Dr. Sturgis.*

2. COMATRICHA CYLINDRICA *(Bilgram) Macbr.*

1905. *Diachaea cylindrica* Bilgram, *Proc. Acad. Nat. Sci. Philad.,* 524.
1911. *Diachaea cylindrica* Bilgram, List., *Mycetozoa, 2nd ed.,* p. 121.

Sporangia cylindrical with obtuse apex, sessile, gregarious, irides-

cent, steel-gray or bronze, 1 to 1.7 mm. high, .5 to .65 mm. thick; hypothallus whitish, rugose; sporangium-wall membranous, hyaline, not adhering to the capillitium; columella arising from the hypothallus and extending nearly to the apex, brown, very light and semi-translucent near the base, irregular, flexuous, limeless throughout; capillitium brown, radiating from the columella to the periphery, repeatedly branching and anastomosing; spores warted, the warts connected by ridges forming a more or less perfect, coarse reticulation, violaceous, pale, 10–12 μ.

This is a very interesting species closely related to the preceding from which it differs chiefly in the reticulation and generally more uniform character of the spores. The author hesitated about the generic reference, finally referring it to *Diachaea* despite the lack of calcium, because it was sessile and had a peridium rather more persistent than is usual in comatrichas. But the presence of lime in stipe and columella is an essential element in the diagnosis of *Diachaea,* while length of stem is everywhere variable in stipitate forms of every genus, and the persistence of the peridium is also an uncertain factor; hangs on long in C. *typhoides, e. g.*

On dead twigs, etc.—Philadelphia,—*Mr. Bilgram;* New Hampshire.

3. Comatricha flaccida *List.*

1894. *Comatricha flaccida* List., Morg., *Jour. Cin. Soc.,* p. 51.
1894. *Stemonitis splendens,* var. *flaccida* List., *Mycetozoa,* p. 112.
1894. *Comatricha flaccida* (List.) Morg., Macbr., *N. A. S.,* p. 133.
1911. *Stemonitis splendens,* var. *flaccida* List., *Mycetozoa, 2nd ed.,* p. 146.

Sporangia semi-erect, close crowded in tufts two inches in diameter, ferruginous, from a dark brown hypothallus, sessile or short stipitate; columella weak, crooked, percurrent, generally enlarged irregularly at the apex; capillitium of few, slender, brown branches which anastomose sparsely and irregularly as in *C. irregularis,* and present when freed from spores the same chenille-like appearance; spore-mass ferruginous brown; spores by transmitted light bright reddish brown, minutely warted, 8–10 μ.

"Growing on old wood and bark of Oak, Willow, etc. The com-

ponent sporangia 5–10 mm. in length. The early appearance is much like that of a species of *Stemonitis,* but the mature stage is a great mass of spores with scanty capillitium, as in *Reticularia;* the columellas, however, are genuine and not adjacent portions of wall grown together."—*Professor Morgan.*

Professor Morgan's herbarium material is at hand for study. It meets his description, needless to say, very generally. In what remains of the type the membranous connections are obscure; in fact the relation of such peridial (?) fragments to the capillitium in any way, is no longer evident. But in any event the colony does not impress one as something prematurely or improperly developed, a stemonitis gone begging;—nothing of that kind; it is clearly a comatricha, easily identifiable with no trace of a surface net but, with long free tips in plenty.

Misled no doubt, by the peridial fragments referred to, Mr. Lister in *Mycetozoa, l. c.,* associated this with *S. confluens* Cke. & Ell., but entered it as a variety of *S. splendens* Rost., just the same. In the second edition of the *Monograph,* Ellis' species is set out, but Morgan's retains the old position.

In light of present knowledge, the relationship suggested would be difficult of proof. If *C. flaccida* Morgan be related to the *splendens* group at all, it must be with the form known as *S. webberi* Rex., but it differs from this in almost every particular. It has no net, with meshes uniform or diverse; it is clear brown in color, with a tinge of red, beneath the lens; the spores are smaller, distinctly warted and with the reddish tinge of the capillitium; and in short, it seems to be a comatricha and not a stemonitis.

Specimens from western Washington differ in some particulars but are apparently the same thing.

Ohio, Kentucky, Washington, California; not common.

4. COMATRICHA LONGA *Peck.*

PLATE VI., Figs. 2, 2 *a*, 2 *b*.

1890. *Comatricha longa* Peck, *Rep. N. Y. Mus.,* XLIII., p. 24.

Sporangia crowded in depressed masses or tufts, black, long, cylindric, even, stipitate; stipe black, shining, generally very short; hypo-

thallus well developed, black; columella black, slender, weak, generally dissipated some distance below the apex; capillitium of slender brown or dusky threads anastomosing to form an open network next the columella, but extended outwardly in form of long free slender branchlets, now and then dichotomously forked; spore-mass blue-black, spores by transmitted light dark brown, globose, spinulose, some of them faintly reticulate, about 9 μ.

A very remarkable species. Rare in the west, more common, as it appears, in the eastern states. The sporangia occur in tufts about 1 or 2 cm. wide, springing generally from crevices in the bark of decaying logs, especially willow and elm, in swampy places. The sporangia are remarkable for their great length. Generally about 20–25 mm., specimens occasionally reach 50 mm.! The capillitial branches are so remote that the spores are scarcely retained by the capillitium at all. Well described and figured by the author of the species, *Forty-third Rep. N. Y. State Museum,* p. 24, Pl. 3.

New York, Pennsylvania, Ohio, Iowa.

5. Comatricha irregularis *Rex.*

1891. *Comatricha irregularis* Rex, *Proc. Phil. Acad.,* p. 393.

Sporangia crowded in flocculent tufts, very dark brown or black, semi-erect or drooping, 4–5 mm. in height, irregularly cylindric, variable, stipitate; stipe black, distinct, often one-half the total height; hypothallus well developed, brown, shining; columella central, slender, flexuous, reaching the apex, where it blends, by branching, with the capillitium; capillitium loose, open, composed of arcuate threads which radiate from the columella, and are joined together, forming a central, irregular reticulation of large meshes, brown, paler toward the surface, where the free ends are sometimes colorless; spore-mass black, spores by transmitted light brown, minutely warted, 7–8 μ.

Related, no doubt, to *C. longa,* but differing in habit, stature, as in texture and structure of the capillitium. In *C. longa* the inner net is extremely simple, — a row or two of meshes at most, and the radiating branches are long and straight; in the species before us the inner network is well developed, and the radiating branches proportionately shorter and abundantly branching, with pale or white free tips.

Generally, though not always, found growing in the crevices of the bark on fallen logs of various deciduous trees. September. Not common.

This is thought to be *C. crypta* Schw., *N. A. F.*, 2351; but the description under that number does not make clear what form Schweinitz had before him, the present species or *C. longa,* and the herbarium specimen of Schweinitz is "utterly lost"; the later specific name is accordingly adopted.

New England west to the Cascade Mountains; south to Kansas and Texas.

6. Comatricha laxa *Rostafinski.*

Plate V., Figs. 5, 5 *a.*

1875. *Comatricha laxa* Rost., *Mon.*, p. 201.
1877. *Lamproderma ellisiana* Cooke, *Myx. U. S.*, p. 397.
1891. *Comatricha ellisiana* (Cooke) Ell. & Ev., *N. A. F.*, 2696.

Sporangia scattered, gregarious, sub-globose or short cylindric, and obtuse, dusky stipitate; stipe short, black, tapering rapidly upward from an expanded base; hypothallus scant or none; columella erect, rigid, sometimes reaching nearly to the apex of the sporangium, sometimes dichotomously branched a little below the summit, before blending into the common capillitium; capillitium lax, of slender, horizontal branches, anastomosing at infrequent intervals and ending in short, free tips; spores pallid, nearly smooth, 7–9.5 μ.

A very minute, delicate little species, about 1½ mm. high; the stipe half the total height. In general appearance the shorter forms of the species resemble slightly *C. nigra,* but are distinguished by a much shorter stipe and much more open capillitium. The sporangia of *C. nigra* mounted on long capillary stipes always droops more or less; the sporangia of the present species stand rigidly erect. The sporangia vary in form and in the branching of the columella. In the more globose phases, the columella almost always shows a peculiar dichotomy near the apex; in the cylindric types, this peculiar division fails.[1] In fact, the shape is determined chiefly by the mode of branching as affects the columella. Rostafinski's figure, on Tab. XIII, does

[1] See *Addenda, d,* p. 282 following.

not present the type usually seen in this country, nor even in Europe if we may judge from later illustrations.

The species with us has received various names, but so far as can be determined, all apply to the same thing, and comparison of specimens from Mr. Ellis with those from Europe show the correctness of the nomenclature here adopted.

Rare, but widely distributed; across the continent.

7. Comatricha suksdorfii *Ell. & Everh.*

Plate XI., Figs. 9, 10, 11.

1882. *Stemonitis suksdorfii* Ell. & Everh., *Bull. Washb. Coll.*, Vol. I., p. 5.
1892. *Stemonitis suksdorfii* Ell. & Everh., Mass., *Mon.*, p. 76.

Sporangia scattered in small tufts or gregarious, cylindric, obtuse at both ends, sometimes widened above, black, 2–6 mm., stipitate; stipe jet-black, shining, even, about one-half the total height; hypothallus not continuous, dark brown; columella black, rather slender, terminating in two or more large branches just below the apex; capillitium exceedingly dense, dark fuscous or black, the flexuous threads anastomosing in a close network, with abundant free pallid extremities; spores in mass, blue-black, by transmitted light fuscous or dark violaceous-brown, minutely warted, 10–12 μ.

Easily recognizable at sight by its sooty color. Entirely unlike any of the preceding. The type of the capillitium is that of *C. pulchella,* but it is very much more dense and entirely different in color. The sporangia are often widened above, and fairly truncate; the total height about 6 mm. Found on the bark of fallen twigs of *Abies, Larix,* etc. Distributed by Ell. & Everh. under this name as an *exsiccata.* The evanescent peridium is colorless; when free, white or silvery.

8. Comatricha nigra *(Pers.) Schroeter.*

Plate XI, Figs. 1, 2, 3.

1791. *Stemonitis nigra* Pers., Gmel., *Syst. Nat.*, p. 1467.
1801. *Stemonitis ovata,* var. *nigra* Pers., *Syn.*, p. 189.
1863. *Stemonitis friesiana* DeBy., *Rab. Eur. Fung.*, No. 568.
1875. *Comatricha friesiana* (DeBy.) Rost., *Mon.*, p. 200.

1889. *Comatricha nigra* (Pers.) Schroeter, *Pilz. Krypt. Fl. v. Schles.*, I., p. 118.

1894. *Comatricha obtusata* Fr., Lister, *Mycetozoa,* p. 117.

1899. *Comatricha nigra* (Pers.) Schroeter, Macbr., *N. A. S.*, p. 128.

Sporangia scattered, ferruginous or dark brown, globose or ovoid, stipitate; stipe long, hair-like, tapering upward, black; hypothallus none; columella rapidly diminished toward the top, at length dissipated; capillitium of slender flexuous threads, radiating horizontally, repeatedly branching and anastomosing to form an intricate dense network, from the surface of which project a few short hook-like peridial processes; spore-mass black, spores by transmitted light dark violaceous, smooth or nearly so, 7–10 μ.

This species, when typical, is easily recognized by its almost globose sporangia mounted on long slender stocks. These are 2 or 3 mm. high and generally persist, as Persoon noticed, a long time after the sporangium has fallen. The sporangia are at first black; after spore disposal pale ferruginous. In shape they vary from ovate to spherical. Sometimes they are umbilicate below, so that a vertical section would be obcordate. Care must be taken to distinguish the present species from blown-out forms of *Lamproderma.*

This most common species seems to be also the center of widest differentiation. In a valuable paper on the Myxomycetes of Dr. C. H. Peck's Herbarium Dr. Sturgis points out the varying relationships of a group of surrounding forms. According to account *C. nigra* verges on one side to *C. laxa,* on the other to *aequalis* which the Listers enter as varietal here. However, in the former the more rigid, direct and simple branching from the columella is usually determinative; in the latter the color, form, and generally more delicate structure, and a tendency to grow in tufts will serve to distinguish.

In this discussion we have assumed as typical the globose sporangium, with the variations in the direction of ovate, obovate, ellipsoidal, etc., the capillitium flexuous and more richly anastomosing near the columella. On the drier slopes in the mountains of Colorado specimens are especially abundant, in proper season covering apparently the lower surface of every barkless twig or fallen stem or *tree entire!* In such a field one might imagine every possible varia-

tion open to observation. Probably such is the case; but as a matter of fact a single small plasmodium at lower levels will sometimes show greater range of variation than were noted on the mountain-side. The cylindric forms were for some reason few, and when noted were short, though often surmounting stems of double the usual length.

Rostafinski calls this *C. friesiana,* a name suggested by De Bary. By this name the species was commonly known for many years. More recently some writers prefer *C. obtusata* Preuss; but *C. obtusata* Preuss, as figured by that author (Sturm's *Deutsch. Fl.,* Pl. 70), is surely more likely *Enerthenema papillata,* and the author says in his description "capillitio vertice soli innato." Persoon certainly recognized the species, and his description, though brief, is yet applicable to no other European species. There seems no reason why the name he gave should not be permanently adopted. Rostafinski's figure, Tab. XIII., shows an ellipsoidal sporangium, not cylindric.

On the lower levels of the Mississippi valley, the species is not common. Possibly overlooked by reason of its minuteness.

Massachusetts, Pennsylvania, Ohio, Iowa, Colorado, North Carolina, Missouri.

9. Comatricha æqualis *Peck.*

Plate VI., Figs. 3, 3 *a,* 3 *b,* 3 *c,* 3 *d*; and Plate XVIII., Figs. 13, 13 *a,* 13 *b.*

1890. *Comatricha equalis* Peck., *Rep. N. Y. Mus.,* XXXI., p. 42.

Sporangia gregarious, seldom erect, usually inclined, curved or nodding, dark brown, becoming violet, cylindric, acuminate-obtuse, stipitate; stipe about half the total height, 2–2½ mm., black, polished, even; hypothallus well developed, brown, continuous; columella black, tapering gradually, and attaining almost the summit of the sporangium; capillitium dense, of flexuous tawny threads which, by repeated branching, form an intricate network, the free extremities numerous, short, and pale; spores dark violaceous, distinctly warted, 7.5–8 μ.

A very graceful, elegant species, related to *C. pulchella* and *C. persoonii,* but distinct by its much greater size and smaller spores. The specimens before show us the perfection of beauty in this genus;

the polished stipe, the symmetrical capillitium, the soft purple-brown tints, are remarkable, and enable one to recognize the form at sight.

Specimens from Oregon are unusually fine; larger than usual, reach 7 mm. total height, and when blown out present the tints of violet in unusual clearness; var. *C. pacifica.* Plate XVIII., Figs. 13, 13*a*, and 13*b*.

New York, Pennsylvania, Ohio, Illinois; Oregon, *Professor Peck.*

10. Comatricha typhoides *(Bull.) Rost.*

Plate VI., Figs. 1, 1 *a*, 1 *b*.

1772. *Mucor stemonitis* Scopoli, *Fl. Carn.*, II., pp. 493–494 (?).
1774. *Mucor stemonitis* Schaeffer, *Icones. Tab.*, CCXCVII (?).
1780. *Stemonitis typhina* Wiggers, *Prim. Fl. Hols.*, p. 116 (?).
1791. *Trichia typhoides* Bulliard, *Champ. de la France,* p. 119, t. 477, II.
1796. *Stemonitis typhina* Persoon, *Myc. Obs.*, I., p. 57, in part.
1805. *Stemonitis typhoides* (Bull.) D. C., *Fl. Fr.*, p. 257.
1829. *Stemonitis typhoides* (Bull.) Fr., *Syst. Myc.*, III., p. 158.
1873. *Comatricha typhoides* (Bull.) Rost., *Vers.*, p. 7.
1875. *Comatricha typhina* (Pers.) Rost., *Mon.*, p. 197.
1895. *Comatricha stemonitis* (Scop.) Sheldon, *Minn. Bot. Stud.*, p. 473.
1899. *Comatricha stemonitis* (Scop.) Sheld., Macbr., *N. A. S.*, p. 130.
1911. *Comatricha typhoides* Rost., List., *Mycetozoa, 2nd ed.*, p. 157.

Sporangia gregarious, scattered, cylindric, erect, sometimes arcuate, obtuse, 2–3 mm. high, at first silvery, then brown, as the peridium vanishes, stipitate; stipe black, about one-half the total height or less; hypothallus distinct, more or less continuous, reddish-brown; columella tapering upward, black, attaining more or less completely the apex of the sporangium; capillitium, arising as rather stout branches of the capillitium, soon taking the form of slender, flexuous, brownish threads, which by repeated anastomosing form at length a close network, almost as in *Stemonitis,* the free, ultimate branches very delicate and short; spore-mass dark brown; spores by transmitted light, pale, almost smooth, except for the presence of a few scattered but very prominent umbo-like warts, of which four or five may be seen at one time, 5–7.5 μ.

This is our most common North American species. It occurs everywhere on decaying wood, sometimes in remarkable quantity, thousands of sporangia at a time. The plasmodium, watery white in

color, infests preferably very rotten logs of *Quercus,* on which in June the sporangia rise as white or pallid columns. The peridium is exceedingly delicate, less seldom seen here than in some other species, but likely to be overlooked entirely. The spores when fresh have a distinct violet or bluish tinge; in old specimens they are almost colorless. In any case they are well marked by the large papillæ already referred to.

C. typhina, var. *heterospora* Rex, differs from the type in several particulars: the sporangia manifest a closer habit; the capillitium is made up of more slender threads and forms a yet denser network; the spores between the large papillæ are marked by a more or less perfectly formed reticulation.[1]

As to nomenclature, this is our old friend *C. typhina* (Pers.) Rost. It should be, more properly, called *C. typhina* Rost., for it is not Persoon's species exactly. But Scopoli, *l. c.,* by citing Hall, Gleditsch, and Micheli, so describes our form as to leave small doubt that he had before him our common species. Schaeffer's figures also come to the rescue, which, though by no means satisfactory, yet can probably refer to no other species. However, Bulliard gives the first good account and figure, and in concord with the decision of our English colleagues, the name afforded by the famous *Champignons* is here adopted.

Widely distributed. Maine to California, and from British America to Nicaragua.

11. Comatricha elegans *(Racib.) List.*

Plate XVI., Fig. 12.

1884. *Rostafinskia elegans* Racib., *Rozpr. Akad. Krak.,* XII., 77.
1888. *Raciborskia elegans* Berl., *Sacc. Syl.,* VII., p. 400.
1894. *Raciborskia elegans* Berl., List., *Mycet.,* p. 133.
1909. *Comatricha elegans* List., *Br. Mus. Guide to Mycet.,* p. 31.

Sporangia loosely gregarious, globose, purplish-brown, small, 1–1.5 mm. in total height, stipitate; stipe black, subulate, to 1 mm.; colu-

[1] In the *Mycetozoa,* 2nd ed., p. 158, is cited *Stemonitis virginiensis* Rex as a synonym of this variety. By reference to p. 163 of the present volume the Virginian stemonitis is left as Rex assigned it, and if the present variety be synonymous, it should be quoted there. The treatment of the species *C. nigra* in the second edition does not establish such fact, nor with three varieties make for any increasing clearness.

mella at first divided into a few main branches, from which by repeated subdivision the delicate, anastomosing, flexuose capillitial threads take origin; spores pale brownish-violaceous, spinulescent, 8–10 μ.

South Carolina. Colorado: — *Dr. Sturgis.*

12. COMATRICHA RUBENS *Lister.*

1894. *Comatricha rubens* List., *Mycet.*, p. 123.

Sporangia gregarious, globoid or ellipsoidal, 1–1.5 mm., pink-brown, stipitate; peridium persistent below; stipe .5–1 mm., black, shining; columella to more than half the sporangium, giving off on all sides the brownish-violaceous, flexuose threads of the capillitium, somewhat thickened and broadly attached to the persisting peridial cup; spores lilac-brown, spinulescent, 7–8 μ.

Another border species, looking to the lamprodermas. Philadelphia, by courtesy *Mr. Bilgram.*

13. COMATRICHA PULCHELLA *(Bab.) Rost.*

PLATE XIII., Fig. 4, and PLATE XII., Figs. 16 and 16 *a.*

1837. *Stemonitis pulchella* Bab., *Trans. Lin. Soc.*, p. 32.
1841. *Comatricha pulchella* Bab., Berk., *Ann. Mag. Nat. Hist.*, I. vi., p. 431, Pl. XII., 11. *a. b.*
1848. *Stemonitis tenerrima* Curtis, *Am. Jour.*, VI., p. 352.
1873. *Stemonitis tenerrima* Berk. & C., *Grev.*, II., p. 69.
1876. *Comatricha pulchella* (Bab.) Rost., *Mon. App.*, p. 27.
1875. *Comatricha persoonii* Rost., *Mon.*, p. 201.
1894. *Comatricha persoonii* Rost., List., *Mycet.*, p. 122.
1899. *Comatricha pulchella* (Bab.) Rost., Macbr., *N. A. S.*, p. 129.
1899. *Comatricha persoonii* Rost., Macbr., *N. A. S.*, p. 132, *excl. syn.*
1911. *Comatricha pulchella* Rost., List., *Mycet., 2nd ed.*, p. 156.
1911. *Comatricha pulchella* var. *gracilis* Wing., List., *Mycet., 2nd ed.*, p. 156.

Sporangia very minute, 1 mm. high, scattered, ovate or ovate-cylindric acuminate, pale brown or ferruginous, stipitate; stipe short, black, nearly even; hypothallus none, or merely a circular base to the tiny stem; columella straight, gradually tapering, reaching almost if not quite to the apex of the sporangium; capillitium dense, a network of flexuous brown threads, rather broad within, ending in slen-

der tips without; spore-mass brown, spores by transmitted light pale "lilac brown," or pale ferruginous, minutely but uniformly warted, 6–8 μ.

Probably widely distributed but rarely collected. Pennsylvania, Iowa; *Okoboji.* Toronto,—*Miss Currie.*

14. Comatricha ellisii, Morg.

Plate XII., Figs. 15 and 15 *a.*

1894. *Comatricha ellisii* Morg., *Jour. Cin. Soc.,* p. 49.
1899. *Comatricha laxa* Rost., Macbr., *N. A. S.,* p. 127.
1911. *Comatricha nigra* Schroet., List., *Mycet., 2nd ed.,* p. 152.

Sporangia short, erect, oval or ovoid to oblong. Stipe and columella erect, brown and smooth, rising from a thin pallid hypothallus, tapering upward and vanishing into the capillitium toward the apex of the sporangium, the stipe usually longer than the columella. Capillitium of slender pale brown threads; these branch several times with lateral anastomosing branchlets, forming a rather open network of small meshes, ending with very short free extremities. Spores globose, even, pale ochraceous, 6–7 mic. in diameter.

Growing on old pine wood. Sporangium .3–.6 mm. in height by .3–.5 mm. in width, the stipe usually a little longer than the sporangium.

On the strength of the clear descriptions and beautiful drawings of Celakowsky, *Myxomyceten Böhmens,* p. 52; Taf. 2, Figs. 7 and 8, this elegant little species as described by my colleague Professor Morgan was, in the former edition, referred to *C. laxa* Rost. It was then reported from New Jersey only. Since then we have specimens from Ohio and from southern Missouri, all true to form, almost identical. It seems wise accordingly, while recognizing the relationship of the form to both *C. laxa,* and to *C. nigra* as well, to give it here an individual place again. It is very small; but once studied may thereafter be easily recognized by a hand-lens. The form is definite, clean-cut, and the spores are pronouncedly smaller than in either of the two related species.

15. COMATRICHA SUBCAESPITOSA *Peck.*

PLATE XII., Figs. 17, 17 *a.*

1890. *Comatricha subcaespitosa* Peck, *N. Y. Mus. Rep.* 43, p. 25.

Sporangia scattered or sometimes in loose clusters, cylindric, obtuse, about 1.5–2 mm., dark brown, stipitate; stipe short, one-fifth total height; hypothallus minute; capillitium regular, the branching quite uniform parallel, flexuous, brown with a tinge of violet, not dense; columella well-defined, almost percurrent; spores brown in mass, under lens dusky, nearly smooth, 9–10 μ.

The larger spores, regular, erect form, and clustered habit separate this form from others with which it will be naturally associated. See page 283 under *Addenda.*

4. Diachæa *Fries*

1825. *Diachaea* Fries, *Syst. Orb. Veg.*, I., p. 143.[1]

Sporangia distinct, globose or cylindric, the peridium thin, iridescent, stipitate; the stipe and columella surcharged with lime, white or yellowish, rigid, thick, tapering upward; capillitium of delicate threads free from lime, radiating from various points on the columella, branching and anastomosing as in *Comatricha* to form a more or less intricate network, the ultimate branchlets supporting the peridial wall.

Rostafinski placed this genus near the *Didymieae* on account of the calcareous columella and the non-calcareous capillitium. On the other hand the structure of the capillitium and the iridescent simple peridium ally *Diachaea* to *Lamproderma* and the *Stemoniteae;* the only distinction being the calcareous stem. It is simply an intermediate genus to be placed here more conveniently than anywhere else in what is of necessity a linear arrangement.

Key to the Species of Diachæa

A. Stipe and columella white.
  a. Sporangium cylindric . . . . . 1. *D. leucopodia*

[1] It had seemed less necessary to retain the classic orthography in this instance since De Bary and Rostafinski both use *Diachea.* But modern scholarship is nothing if not meticulous; it is the fashion in Latin still to keep the digraph, even to the vexation of all men. In the same way when Bulliard wrote *leucopodia,* 'white stockings', he doubtless meant to be exact.

b. Sporangium globose.
i. Evidently stalked . . . . . 2. *D. splendens*
ii. Stalk very short, .5 mm., conic.
* Spores warted . . . . . 3. *D. bulbillosa*
** Spores faintly netted . . . . 4. *D. subsessilis*
B. Stipe yellowish or orange . . . . . 5. *D. thomasii*

1. Diachæa leucopodia *(Bull.) Rost.*

1791. *Trichia leucopodia* Bull., *Champ. de la France,* Pl. 502, Fig. 2.
1825. *Diachaea elegans* Fries, *Syst. Orb. Veg.,* I., p. 143.
1875. *Diachaea leucopoda* (Bull.) Rost., *Mon.,* p. 190.

Sporangia rather closely gregarious, metallic blue or purple iridescent, cylindric or ellipsoidal, obtuse, sub-umbilicate below, stipitate; stipe short, much less than one-half the total height, snow-white, tapering upward; hypothallus white, venulose, occurring from stipe to stipe to form an open network over the substratum; columella thick, cylindric, tapering, blunt, terminating below the apex, white; capillitium springing from every part of the columella, of slender threads, brown, flexuous, branching and anastomosing to form an intricate net; spores in mass nearly black, by transmitted light dull violaceous, minutely roughened, 7–9 μ.

A very beautiful species; not uncommon in the eastern states; rare west of the Mississippi. Easily recognized, amid related forms, by its snow-white stem, a feature which did not escape the notice of Bulliard and suggested the accepted specific name. Fries adopted the specific name proposed by Trentepohl and wrote *D. elegans,* simply because to him the peridium was "admodum elegans."

The peridium is exceedingly thin and early deciduous; the stipe long persistent. The plasmodium, dull white, was observed by Fries at the beginning of the century; "morphoseos clavem inter myxogastres hoc genus primum mihi subministravit."

This species, as the diachæas generally, affects fallen sticks and leaves in orchards and forests and even spreads boldly over the foliage and stems of living plants.

New England, New York, Pennsylvania, Maryland, Virginia, South Carolina, Ohio, Iowa, California, Canada.

2. Diachæa splendens *Peck.*

Plate VII., Figs. 1, 1 *a*, 1 *b*, 1 *c*.

1877. *Diachaea splendens* Peck, *Rep. N. Y. Mus.*, XXX., p. 50.

Sporangia gregarious, metallic blue with brilliant iridescence, globose, stipitate; stipe white, short, tapering upward; hypothallus white, venulose, a network supporting the snowy stipes; columella white, cylindric, passing the centre, obtuse; capillitium lax, of slender, anastomosing, brown, translucent threads; spores in mass black, by transmitted light dark-violaceous, very coarsely warted, 7–10 μ.

This is perhaps the most showy species of the list. The globose brilliantly iridescent sporangia are lifted above the substratum on snow-white columnar stalks; these are again joined one to another by the pure white vein-like cords of the reticulate hypothallus. The plasmodium may spread very widely over all sorts of objects that come in the way, dry forest leaves and sticks, or the fruit and foliage of living plants. Closely resembling the preceding, but differing in the globose sporangia, it may be instantly recognized under the lenses by its coarsely papillate spores.

Not common. New York, Pennsylvania, Ontario, Ohio, Iowa, Nebraska.

3. Diachæa subsessilis *Pk.*

1879. *Diachaea subsessilis* Pk., *Rep. N. Y. Mus. Nat. History*, XXXI., p. 41.
1894. *Diachaea subsessilis* Pk., Lister, *Mycetozoa*, p. 92.

Sporangia gregarious or closely crowded, small, about .5 mm., dull iridescent-blue, greenish-gray, etc., globose or depressed-globose, short-stalked or nearly sessile; stipe generally very short, reduced sometimes to a mere persistent cone, white; columella obsolescent or reduced to white conical intrusion of the stipe; capillitium radiating from the stipe, brown, consisting of branching, anastomosing threads, paler at the tips; hypothallus very scanty or none; spores minutely warted, the papillæ arranged in an irregular, loose net-work, violet-brown, paler under the lens, 10–12 μ.

This species is easily recognizable by its diminutive size and generally defective structure; i. e. it has the appearance of a degenerate or

depauperate representative of some finer form. Besides the type, yet to be seen in Albany, Dr. Sturgis reports the species from Connecticut and from the Isle of Wight! A small gathering is before me from Colorado. Every sporangium is borne upon a calcareous pedicel, very short indeed, but real. The *var. globosa* referred to in the English text under *D. leucopodia* has not appeared so far as reported, on this side the sea, but even such variety could scarcely in the hands of a collector take the place of the form now under consideration.

Specimens of *D. subsessilis* from Europe correspond remarkably with those described by Drs. Peck and Sturgis. Mr. Lister would have our species a synonym for *Lamproderma fuckelianum cracovense* (Rost.) Cel.

Rare; from Connecticut to Colorado.

4. Diachæa bulbillosa *(Berk. & Br.) List.*

1873. *Didymium bulbillosum* Berk. & Br., *Jour. Linn. Soc.*, XIV., p. 84.
1898. *Diachaea bulbillosa* Lister, *Jour. Bot.*, XXXVI., p. 165.
1911. *Diachaea bulbillosa* Lister, *Mycetozoa, 2nd ed.*, p. 119.

Sporangia gregarious, globose, small, iridescent purple, stipitate; stipe conical, white, sometimes brown, half-a-mm., half the total height; columella clavate, white or brown; capillitium of purple-brown threads united to form a lax net; spores violet-grey, marked with scattered warts "6–8 in a row across the hemisphere", 7–9 μ.

Java, *Berkeley & Broome, op. c.* Toronto, Canada; cited here by courtesy of Miss Currie who gives the spores 7.8 μ.

5. Diachæa thomasii *Rex.*

Plate V., Fig. *6, 6 a.*

1892. *Diachaea thomasii* Rex, *Proc. Phil. Acad.*, p. 329.

Sporangia gregarious, more or less crowded, purple and bronze, iridescent, globose sessile or short stipitate; stipe, when present, very short, thick, tapering rapidly upward, orange; hypothallus orange, prominent venulose, continuous; columella ochre yellow, rough, cylindric, tapering upward to one-half the height of the sporangium, obtuse; capillitium lax, of slender brown rigid threads, radiating from the columella in every direction, anastomosing to form a loose, large-

meshed network; spore-mass brown; spores by transmitted light violaceous, minutely, unevenly warted, 10–12 μ.

The peculiar orange color of the calcareous deposits in stipe and columella easily distinguish this species. The capillitium is also distinctive, rigid, simple, and comparatively scant, lamprodermoid. Rex calls attention to the fact that under low magnification the spores appear spotted; but the spots are occasioned simply by the closer aggregation, at particular points, of the ordinary papillæ.

A southern species. All the specimens so far reported are from the mountains of North Carolina.

The specimens referred to under this name by Lister, *Mon.*, p. 92, as coming from "Kittery, U. S. A." (Kittery, Maine?), are, no doubt, according to Mr. Lister's figures, *Comatricha caespitosa* Sturgis. See under that species.

C. LAMPRODERMACEÆ

Sporangia distinct, generally gregarious, more or less spherical; capillitium developed chiefly or solely from the summit of the columella.

Key to the Genera of the Lamprodermaceæ

A. Columella percurrent; capillitium from a disk at the apex, 1. ENERTHENEMA
B. Columella scarce reaching the centre of the sporangium.
  a. Capillitium not forming a net . . . 2. CLASTODERMA
  b. Capillitium forming an intricate net . . 3. LAMPRODERMA
  c. Minute, capillitium rudimentary . . 4. ECHINOSTELIUM

1. Enerthenema *Bowman*

1828. *Enerthenema* Bowman, *Trans. Linn. Soc.*, XVI., p. 152.

Sporangia stipitate, the stipe extended as a columella, which entirely traverses the sporangium and forms at the apex an expanded disk; from this depends the capillitium.

Key to the Species of Enerthenema

A. Spores free . . . . . 1. *E. papillatum*
B. Spores in clusters . . . . . 2. *E. berkeleyanum*

1. Enerthenema papillatum *(Pers.) Rost.*

Plate V., Fig. 3.

1801. *Stemonitis papillata* Pers., *Syn.*, p. 188.
1828. *Enerthenema elegans* Bowm., *Trans. Linn. Soc.*, XVI., p. 152.
1862. *Comatricha obtusata* Preuss, Sturm, *Deutschl. Flora*, Pl. LXX.
1876. *Enerthenema papillatum* (Pers.) Rost., *Mon. App.*, p. 28.

Sporangia scattered or crowded, stipitate, spheroidal, naked, black fuscous, above, shining, adorned with a minute, black papilla; stipe black, opaque, conical or attenuate upward, about equal to the peridium; columella at the apex expanded into a shining disk; capillitium springing from the lower side of the disk or from its edge, made up of scarcely forked threads which are free below; spores violaceous or fuscous black, minutely warted, 10–12 μ.

Rare. Wisconsin, Ohio, South Carolina, Illinois, Pennsylvania, Iowa, Colorado.

This is one of the few species so well marked that Persoon's description, *l. c.*, is definitive: "Stylidio toto penetrante. Capillitium exacte globosum, sub-compactum, in eius apice stylidium papillæ in modum prominet." For this reason Bowman's specific name *elegans* is discarded.

2. Enerthenema berkeleyanum *Rost.*

1876. *Enerthenema berkeleyanum* Rost., *Mon. App.*, p. 29.
1913. *Enerthenema syncarpon* Sturgis, *Myxo. Col.*, II., p. 448.

This species corresponds to the preceding in all respects except in the fact that the spores are clustered in groups of four to twelve and are a little larger, 11–13 μ, strongly spinulose on the exposed surface.

Dr. Sturgis reports this from Colorado, *l. c.*, but discards Rostafinski's specific name on the ground that the type has disappeared; only the spores of some fungus hyphæ remain in the place and these may have been mistaken by Berkeley. This seems hardly possible since such supposition would not account for the generic reference either by Berkeley (and Broome) or by Rostafinski. The description in the *Monograph* is minute as that of one who had the form under his lenses. Rostafinski *saw* Berkeley's specimens.

For a similar case, see under *Prototrichia metallica, Mycetozoa 2nd ed.,* p. 261.

South Carolina, type; Colorado.

2. Clastoderma *Blytt*

1880. *Clastoderma* Blytt, *Bot. Zeit.,* XXXVIII., p. 343.

Sporangium globose, distinct, stipitate; the columella short or obsolete; the capillitium of few sparsely branched threads, which bear at their tops the persistent fragments of the peridium, but are not otherwise united.

Distinguished from *Lamproderma* by the peculiar manner in which the peridium is ruptured, and by the simplicity of the scanty capillitium. So far there appears to be but a single species.

1. Clastoderma debaryanum *Blytt.*

Plate XIII., Fig. 6, and Plate XVI., Fig. 13.

1880. *Clastoderma debaryanum* Blytt, *Bot. Zeit.,* XXXVIII., p. 343.
1886. *Orthotrichia microcephala* Wing., *Jour. Myc.,* II., p. 126.

Sporangia scattered or gregarious, very minute, 1-12 to ¼ mm. in diameter, the peridium fugacious, except the minute patches that adhere to the capillitial branchlets, and the slight annulus at the base of the columella; stipe long, unequal, dark below, above paler; columella almost none, giving early rise to the comparatively few slender threads which by their repeated forking make up the capillitium; spores globose, even, violaceous, 8–9 μ.

Reported in the United States so far from Maine, Pennsylvania, Ohio, and Illinois.

The sporangia are very small, but beautiful, delicate little structures, found on the bark of living red oak in this country; in Norway it seems to have been seen first on a dead polyporus. Its minuteness doubtless causes it to be generally overlooked, *N. A. F.,* 2498.

3. Lamproderma *Rostafinski*

1873. *Lamproderma* Rostafinski, *Versuch,* p. 7.

Sporangia stipitate, globose, or ellipsoid; columella cylindric or inflated or clavate at the apex, scarcely attaining half the height of

the peridium; peridium shining with metallic tints, deciduous, except where, at the base of the columella, it forms a ring around the stipe; capillitium rising in tufts or by simple branches from the columella, the threads regularly forked, generally united into a net.

The lamprodermas are distinguished from the comatrichas, to which they are most nearly allied, by the arrangement of the capillitium, its development from the apex only of the columella, the continuation of the stipe within the peridium. In other words, the peridium leaves the stipe some distance below the point where the lowest capillitial branches take origin. In mature specimens the peridium has often entirely disappeared, its only trace, a collar, more or less distinct, around the stipe, marking the beginning of the columella. Nevertheless the peridium is far more persistent than in any comatricha, and shows in yet greater brilliancy the wondrous metallic tints and iridescence of *Comatricha* and *Diachaea*. Older authors, so far as can be seen, distributed the species between *Physarum* and *Stemonitis*.

Key to the Species of Lamproderma

A. Peridium metallic blue.
  a. Stipe short, stout.
    1. Capillitium tips colorless . . . 5. *L. violaceum*
  b. Stipe long, slender.
    1. Capillitium of dark, tapering, oft-united threads, 3. *L. columbinum*
    2. Capillitial threads rigid, dark brown, seldom united, 4. *L. scintillans*

B. Peridium not blue, silvery.
  a. Stipe long, slender.
    1. Capillitium very intricate, forming a compact net, 6. *L. arcyrionema*
    2. Capillitium of rigid dark brown threads 1. *L. physaroides*
  b. Stipe short, heads large, 1 mm. or more . 2. *L. robustum*

1. Lamproderma physaroides *(Alb. & Schw.) Rost.*

1805. *Physarum physaroides* Alb. & Schw., *Consp. Fung.*, p. 103.
1875. *Lamproderma physaroides* (Alb. & Schw.) Rost., *Mon.*, p. 202.

Sporangia gregarious, wide-spreading, globose, the peridium persistent with a silver metallic, sometimes brassy, lustre; stipe long, brown or black, tapering upward; hypothallus well developed, brown

or purple, usually not continuous; columella swollen, obtuse, short at best, hardly attaining the centre of the sporangium; capillitium very rigid, of simple or sparingly branched, dark-brown threads radiating from the clavate apex of the columella and only here and there anastomosing toward the surface, the ultimate divisions distinctly rough; spores lilac brown, rough, 10–12.5 μ.

This species is well described and illustrated in Rostafinski's *Monograph.* It is well marked by its clavate columella and peculiarly simple, dark rigid capillitium, the branches of which rise in great numbers immediately from the columella, and maintain their primitive thickness during the greater part of their length. The transverse vincula are often at right angles to the principal branches, and the meshes, where formed, are often long and rectangular. Externally, it resembles *L. arcyrionema,* but is by its spores and capillitium instantly distinguished. Rostafinski gives the spores 12.5–14.2 μ. Large spores are less common in the specimens before us. Lister figures a sessile variety.

In our first edition this species was entered from lists published for New England, New York, and Ohio. The intervening years, however, have brought no confirmation. Specimens from Maine and Ohio, with large spores, represent *L. columbinum,* and those cited for New York are forms of *L. violaceum.* It is accordingly doubtful that *L. physaroides* (A. & S.) Rost. occurs in North America. That it is to be found in Europe there seems no doubt. The figure and description by Schweinitz, *l. c.,* may indeed be inconclusive, but Rostafinski's citation and abundant description leave no doubt as to his opinion; while numerous localities named would indicate adequate material. What Rostafinski described will no doubt obtain wider recognition some day.

2. LAMPRODERMA ROBUSTUM *Ell. & Evh.*

1892. *Lamproderma robustum* Ell. & Evh., Mass., *Mon.,* p. 99.
1894. *Lamproderma violaceum* var. *sauteri* Rost., List., *Mycetozoa,* p. 129.
1899. *Lamproderma sauteri* Rost., Macbr., *N. A. S.,* p. 140.

Sporangia gregarious, globose, dull black, the peridium when present silvery, shining, or simply smooth, transparent and without irides-

cence, stipitate; stipe short, black, tapering rapidly upward, annulate with the persisting base of the peridium; columella short, thick, truncate, and widened at the top; hypothallus well developed, brown or purple; capillitium dense, made up of dark brown branches, numerous and rather slender, repeatedly branched and anastomosing toward the surface to form a slight delicate network with abundant free ends; spores dark purple brown, rough, 14–16 μ.

This species in outward appearance resembles *L. physaroides,* from which it is easily distinguished by the much greater diameter of the globose sporangium, 1 mm. or more. The persistent base of the peridium is also characteristic, very prominent sometimes, and visible to the naked eye. The capillitium is also unlike that of *L. physaroides;* resembles more nearly that of *L. violaceum.* From the latter species *L. robustum* is distinguished by the color of the peridium, and by the larger, darker spores and generally different capillitium. In our former edition this is called *L. sauteri* Rost. That much-quoted author distinguished *L. violaceum* and *L. sauteri;* the English authors make the last named a variety only of the former. This our American species is *not.*

It is, as presented in our western mountains, clear-cut, well defined, not a variety of anything. The original name is therefore restored.

Lamproderma arcyrioides (Somm.) Morgan is probably a form of *L. columbinum.* The original *L. arcyrioides* has not yet been certainly identified in North America; see following species.

Colorado, Oregon, Washington, California.

3. Lamproderma columbinum *(Pers.) Rost.*

1796. ***Physarum columbinum*** Pers., *Obs. Myc.,* I., p. 5.
1875. ***Lamproderma columbinum*** Rost., *Mon.,* p. 203.

Sporangia scattered, gregarious; rich violet or purple with metallic iridescence, globose, stipitate; the stipe long, three-fourths the total height, slender, subulate, black; hypothallus scant, purplish or brown; columella small, one-third the height or less, tapering or acute, black; the capillitium brown throughout, not dense, arising from nearly all parts of the columella, freely branching and anastomosing to an open, large-meshed network; spore-mass black, spores by transmitted light dark brown, rough, 10–12 μ.

Rostafinski distinguished this beautiful species by the color of the peridium and the conic columella. According to Mr. Lister, Rostafinski was not specially careful in labelling his material, different forms having been included under this specific name. Nevertheless, the description is well drawn, and excludes *L. physaroides* completely. At all events our American specimens correspond so well with the description of *L. columbinum* (Pers.) Rost. that there seems no doubt that we have here what the Polish author figured and described, whether or not he was always consistent in applying his labels. The color distinguishes at sight the present species from *L. physaroides,* and the capillitium and large rough brown spores distinguish it from *L. violaceum.* The capillitium of the minute *L. scintillans* is much denser and more rigid, and the spores smaller. The stipe when dry is ciliate.

This is the common species of our western mountains, especially on the Pacific slope. In the Cascades every dark ravine is certain to show it in later summer and autumn, far extended colonies covering the moist surfaces of every mouldering log; the myriad globoid sporangia giving back when brought to the sunlight the most extravagant blues and greens with all the splendor of metallic sheen, their brilliant beauty never fails to quicken the attention of even the most insensate tourist.

Abundant in the western forests, in the east extremely rare; Maine, Pennsylvania, South Carolina, Washington, Oregon; Vancouver, Canada.

4. LAMPRODERMA SCINTILLANS *(Berk. & Br.) Morg.*

PLATE V., Figs. 2, 2 *a.*

1877. *Stemonitis scintillans* Berk. & Br., *Jour. Linn. Soc.,* XV., p. 2.
1877. *Lamproderma arcyrioides,* var. *iridea* Cke., *Myx. G. B.,* p. 50.
1892. *Lamproderma irideum* (Cke.) Mass., *Mon.,* p. 95.
1894. *Lamproderma scintillans* (Berk. & Br.) Morg., *Jour. Cin. Soc.,* p. 47.

Sporangia gregarious, scattered, globose or depressed-globose, rich metallic blue or purple, iridescent, stipitate; the stipe long, slender, even, inclined and nodding or sometimes erect; hypothallus small, circular; columella cylindric, small, not reaching the centre, black;

capillitium dense, of rigid, straight, sparingly branched or anastomosing, brown threads, which are sometimes white or colorless just as they leave the columella; spores globose, rough, violaceous brown, 8 μ.

This is *L. irideum* of Cooke and of Massee's *Monograph.* Its capillitium is remarkable, and constitutes an easy diagnostic mark. The threads appear at first sight entirely simple, but are really several times furcate, and not infrequently anastomose. The spores are covered with sparsely sown large papillæ, easily seen under moderate magnification.

This is one of our earliest species. To be sought in May on beds of decaying oak leaves in the woods, especially in wet places, near streams, etc.

Rare. New England, Pennsylvania, Ohio, Iowa.

5. LAMPRODERMA VIOLACEUM *(Fries) Rost.*

1829. *Stemonitis violacea* Fries, *Syst. Myc.,* III., p. 162.
1875. *Lamproderma violaceum* (Fries) Rost., *Mon.,* p. 204.

Sporangia closely gregarious or scattered, depressed-globose, more or less umbilicate below, metallic blue or purple, sessile or short stipitate; stipe stout, dark brown or black, even; hypothallus, when the sporangia are crowded, a thin, continuous, purplish membrane; when the sporangia are scattered, the hypothallus discoidal; columella cylindric or tapering slightly upward, the apex obtuse, black, attaining the centre of the sporangium; capillitium lax and flaccid, made up of flexuous threads branching and anastomosing to form a network, open in the interior, more dense without, the threads at first pale brown as they leave the columella, becoming paler outward to the colorless tips; spores minutely warted, violaceous gray, 9–11 μ.

This is our most common species; found on decaying sticks and logs late in the fall. Its pale capillitium will usually distinguish it, especially where the sporangia are empty; then the pallid free extremities of the capillitial branches give to the little spheres under the lens a white or hoary appearance not seen in any other species.

The plasmodium is at first almost transparent, then amber tinted, sending up tiny semi-transparent spheres on shining brownish stalks.

As the changes approach maturity, the sporangia become jet-black, and only at last when the spores are ready for dispersal does the peridium assume its rich metallic purple tints. Colonies a meter in length, two or three decimeters in width, are sometimes seen!

New England, New York, Pennsylvania, Ohio, Indiana, Illinois, Iowa, South Dakota; Toronto. Common.

6. LAMPRODERMA ARCYRIONEMA *Rost.*

PLATE V., Figs. 1, 1 *a*.

1875. ***Lamproderma arcyrionema*** Rost., *Mon.*, p. 208.

Sporangia gregarious, scattered, globose, silvery gray or bronze, iridescent, erect, stipitate; stipe black, long, two-thirds to three-fourths the total height, slender, rigid; columella slender, cylindric, attaining about one-third the height of the sporangium when it breaks into the primary branches of the capillitium; capillitium exceedingly intricate, made up of slender, flexuous brown threads which frequently branch and anastomose to form an elegant round-meshed network resembling that of *Arcyria,* free ultimate branchlets not numerous; spores in mass jet-black, by transmitted light violaceous, smooth, or only faintly warted, 6–8 μ.

In outward appearance this species resembles *L. physaroides,* but is easily recognizable by its very peculiar capillitium. This, in its primary branching, resembles a comatricha. In typical forms, the columella branches at the apex only, generally into two strong divisions which then break up irregularly and anastomose in every direction. This seems to have been the form present to Rostafinski when he wrote "columella truncate." In Central American and some North American specimens, the branching is very different; the twigs leave the columella at various points almost down to the annulus, and the entire effect is dendroid. The columella is lost almost at once. A small form of this species was formerly distributed in the United States as *Comatricha friesiana* DeBy. This circumstance led the present author to describe Central American forms as *C. shimekiana.* Judging from a remark by Massee (*Mon.*, p. 97), a similar confusion seems to have prevailed in Europe. As a matter of fact, the resem-

blance between *C. friesiana,* i. e. *C. nigra,* and the present species is sufficiently remote.

Lamproderma minutum Rostafinski seems to be a small form of this species. Rostafinski bases his diagnosis upon the branching of the columella, which is, as we have seen, inconstant, and upon the colorless capillitium. This feature in specimens examined is also inconstant.

Occurring in large colonies on barkless decaying logs of various species; the plasmodium almost colorless.

New England, Pennsylvania, Ohio, Louisiana, Texas, Mexico, Nicaragua; Vancouver's Island; Ontario, Toronto,—*Miss Currie.*

4. Echinostelium *DeBary*

1873. *Echinostelium* DeBary, Rost., *Versuch,* p. 7.

Sporangia distinct, globose, minute, the structure limited to a few imperfect rib-like, loosely joined branches developed from the short columella or stem-top, sustaining the spores.

A single species: —

1. Echinostelium minutum *DeBy.*

1873. *Echinostelium minutum* DeBy., Rost., *Versuch,* p. 7.

Plate XIX., Figs. 11 and 11 *a*

Sporangia distinct, scattered, globose, very minute, 40–50 μ, stipitate; the stipe, hair-like subulate, granular but hyaline; columella minute or none; capillitium consisting of a few arcuate spinose threads loosely united supporting the uncovered spores, spores globose, colorless, smooth, 7–8 μ.— *Rostafinski.*

This very singular and diminutive form, the least of all slime-moulds, is probably widely distributed but the accident of discovery is rare. DeBary found it once only, at Frankfurt am Main.

Miss Lister reports its occurrence in England and Austria. In the United States it has been seen but once on certain laboratory material from Massachusetts, studied by Dr. Thaxter.

Our drawing is after Rostafinski, IV., 68; Miss Lister follows No. 54, and so finds a bit of peridium below the two spores shown in the figure, one on each side of a microscopic *columella.*

This is almost the only taxonomic suggestion;—a mere suggestion; this microscopic bit of anxious life is but a shadow,—a shade, a shadow of a lamproderma!

Order III

CRIBRARIALES

Fructification plasmodiocarpous or æthalioid, or consisting of distinct sporangia; peridia membranaceous at maturity, more or less evanescent, opening irregularly or by means of a delicate network, which involves at least the upper part of the sporangium; capillitium usually none; spores of some shade of brown, umbrine, rarely purplish.

This order is distinguished — except in a single case — by the entire absence of true capillitium, the pallid or brown spores, the gradual evolution of distinct sporangia in which provision for spore-dispersal is made by peridial modification especially at the sporangium-top.

Key to the Families of the Cribrariales

A. Fructification plasmodiocarpous scattered as if made up of the segments of the plasmodial net . . . . . Liceacæ

B. Fructification of distinct and separate sporangia, long stipitate, opening by a delicate operculum at the top . . . Orcadellaceæ

C. Fructification æthalioid, the sporangia generally more or less tubular, often prismatic by mutual pressure; opening by rupture of the apex, the lateral walls entire . . . . . Tubiferaceæ

D. Fructification æthalioid, the sporangia ill defined, their walls more or less perforate, frayed, or dissipated, forming a pseudo-capillitium, Reticulariaceæ

E. Fructification of distinct and separate sporangia, the walls more or less reticulately perforate especially above . . . Cribrariaceæ

A. LICEACEÆ

A single genus, —

1. Licea *(Schrader) Rost.*

1797. *Licea* Schrader, *Nov. Gen. Plant.*, p. 16, in part.
1875. *Licea* (Schrader) Rost., *Mon.*, p. 218.

Sporangia plasmodiocarpous, looped, irregular, or distinct, sessile,

and regularly rounded or elliptical; the peridium simple, rather firm, ruptured irregularly or by simple fissure; hypothallus none.

This genus is distinguished from other similar plasmodiocarpous forms by the extreme simplicity of its structure. There is absolutely no capillitium nor anything like it, simply a mass of spores surrounded by thin membranous walls. The spores range from pale olive, colorless under the lens, through various shades of brown to dusky almost black in *L. pusilla.* Schrader included the *Tubifera* species.

Key to the Species of Licea

A. Plainly plasmodiocarpous . . . . . 1. *L. variabilis*
B. Opening by regular segments.
1. Segments two only . . . . . 3. *L. biforis*
2. Segments several.
i. Spores brown . . . . . 4. *L. minima*
ii. Spores dusky olive . . . . . 5. *L. pusilla*

1. Licea variabilis *Sckrader.*

Plate XII., Figs. 7 and 8.

1797. *Licea variabilis* Schrader, *Nov. Gen.,* p. 18, Pl. VI., Figs. 5 and 6.
1801. *Licea variabilis* Schr., Pers., *Syn. Meth.,* p. 197.
1801. *Licea flexuosa* Pers., *Syn. Meth.,* p. 197.
1911. *Licea flexuosa* Pers., List., *Mycetozoa, 2nd ed.,* p. 189.

Fructification plasmodiocarpous, elongate, hamate, annulate or irregularly repent, very dark brown, rough, the peridium of two layers, the outer closely adhering, dark brown, thick, opaque, the inner delicate, membranous, very thin, transparent, iridescent, rugulose, rupturing irregularly; hypothallus none; spores in mass pale yellow with a greenish tinge, by transmitted light nearly colorless, large, globose, minutely spinulose, 12.5 μ.

This is the largest species of the genus as represented in this country, the plasmodiocarps of various lengths and from .5–.7 μ wide. Somewhat resembling some species of *Ophiotheca,* but of much darker color. The outer peridium is deciduous, and the inner slowly ruptures, by irregular fissures discharging the spores. The plasmodium, according to Schrader, is white. Rare. Probably overlooked.

Any good reason for changing the name given to this form so well

illustrated and described by Schrader does not appear. Persoon quotes his predecessor's species and adds *L. flexuosa* on his own account; strangely enough, since Schrader expressly describes *L. variabilis,* "in uno eodemque enim loco peridium hemisphericum, ovatum, oblongum *flexuosum* vel aliter formatum diversi est diametri."

New York, Pennsylvania, Ohio, Iowa.

Licea flexuosa Pers. is by Schweinitz reported from Pennsylvania. It is described as having brown spores, 10–15 μ, spinulose.

2. LICEA BIFORIS *Morgan.*

PLATE XII., Fig. 10.

1893. *Licea biforis* Morgan, *Jour. Cin. Soc.,* p. 5.

Sporangia regular, compressed, sessile on a narrow base, gregarious; the wall firm, thin, smooth, yellow brown in color and nearly opaque, with minute, scattered granules on the inner surface, at maturity opening into two equal parts, which remain persistent by the base; spores yellow-brown in mass, globose or oval, even, 9–12 μ.

Minute but perfectly regular, almost uniform, corneous-looking sporangia are thickly strewn over the inner surface of decaying bark. Each, at first elongate, pointed at each end, opens at length by fissure along the upper side setting free the minute yellowish spores. Unlike anything else; reminding one, at first sight, of some species of *Glonium.*

Inside bark of *Liriodendron.* Ohio, Canada.

3. LICEA MINIMA *Fries.*

1829. *Licea minima* Fries, *Syst. Myc.,* III., p. 199.

Sporangia gregarious, umber-brown, spherical or hemispherical, sessile; the peridium opaque, brown, opening along pre-figured lines, forming segments with dotted margins, ultimately widely reflexed; spores in mass dark brown, by transmitted light paler with olive tints, minutely roughened, 10–11 μ.

The very minute sporangia, 3 mm., of this species cause it to be overlooked generally by collectors. Nevertheless, it may be found on decaying soft woods, in August, probably around the world. The

number of sporangia produced by one plasmodium is in Iowa also small. The larger specimens might be mistaken for species of *Perichaena,* but are easily distinguished by the regular and lobate dehiscence. The plasmodium is yellow.

Dr. George Rex, in almost the last paper from his hand, gives an interesting account of this diminutive species. Among various gatherings studied he found a black variety, a melanistic phase, so to say, and was able to follow the evolution of the sporangia from the yellow plasmodium. The sutures by which the peridium opens, first show signs of differentiation by change of color from yellow through garnet to black. Later the entire wall undergoes similar color changes, beginning next the completed sutural delimitations. Of the open peridia, the reflexed segments remind one of certain didermas, as *D. radiatum.* See *Bot. Gaz.,* Vol. XIX., p. 399.

New England, New York, Pennsylvania, Iowa.

4. Licea pusilla *Schrader.*

1797. *Licea pusilla* Schrad., *Nov. Gen. Pl.,* p. 19, tab. VI., f. 4.
1829. *Physarum licea* Fries, *Syst. Myc.,* III., p. 143.
1875. *Protoderma pusilla* (Schrader) Rost., *Mon.,* p 90.

Sporangia scattered, gregarious, depressed-globose, sessile on a flattened base, dark brown, shining, .5–1 mm.; peridium thin, dark colored, translucent, dehiscent above by regular segments; spore-mass almost black, spores by transmitted light olivaceous brown, smooth, or nearly so, 15–17 μ.

Fries, *l. c.,* makes this a physarum, and argues the case at length, evidently with such efficiency that he greatly impressed Rostafinski, who did not make it a physarum indeed, but actually gave it generic place and station of its own; a physarum may do without calcium in the capillitium perhaps, but not be entirely non-calcareous; so he writes *Protoderma* (first cover) and places the species number 1 on the long list of endosporous forms. Even in his *'Dodatek',* or supplement, as we should say, he refers to the thing again, but only to correct the inflexional ending of the specific name; he writes *Protoderma pusillum* (Schrader) Rost!

Schweinitz reports the species for America and Morgan cites

Schweinitz and reports it for Ohio, but we find it in no American collections.

B. ORCADELLACEÆ

Sporangia distinct, minute, long stipitate, opening above by a distinct lid.

A single genus, —

Orcadella *Wingate*

1889. *Orcadella* Wingate, *Proc. Phil. Acad.*, p. 280.

Sporangia furnished with rigid, unpolished stipes, blending above with the substance of the thick unpolished walls; the operculum thin, delicate, membranaceous.

A single species, —

1. ORCADELLA OPERCULATA *Wingate.*

PLATE XII., Fig. 11.

1889. *Orcadella operculata* Wingate, *Proc. Phil. Acad.*, p. 280.

Sporangia scattered, gregarious, ellipsoidal, ovoid, obconical or nearly globose, dull brown or blackish, the wall simple, thick, coarse, at the top replaced by a delicate, thin, yellowish, iridescent, lustrous or vernicose membrane which forms a circular, smooth, or wrinkled lid, soon deciduous; stipe of varying height, rough from deposit of plasmodic refuse; spores, in mass yellowish, globose, smooth, 8–11 μ.

This curious little species, well described by its discoverer, appears to be very rare. At least it is seldom collected; overlooked by reason of its minuteness. It is a stipitate licea, or a lid-covered cribraria; perhaps nearer the former. It affects the bark of species of *Quercus,* and seems to be associated there with *Clastoderma debaryanum. N. A. F.,* 2497.

Pennsylvania, Maine.

C. TUBIFERACEÆ

Fructification æthalioid or of distinct sporangia; sporangia well defined, tubular, often prismatic by mutual pressure, seated on a common, well-marked hypothallus, at length dehiscent by the irregular

rupture of the peridium, in typical cases at the apex, its walls remaining then otherwise entire; capillitial threads in No. 3, only.

Key to the Genera of the Tubiferaceæ

A. Spores olivaceous; sporangia in one or several series, 1. LINDBLADIA
B. Spores umber; sporangia in a single series . . . 2. TUBIFERA
C. Sporangia stipitate; capillitium of tubular threads . 3. ALWISIA

1. Lindbladia *Fries*

1849. *Lindbladia* Fries, *Sum. Veg. Scand.*, p. 449.

Fructification æthalioid; the sporangia short, tubular, sometimes superimposed, sometimes forming a simple stratum, in the latter case generally sessile, but sometimes short-stipitate, the peridium at first entire, at length opening irregularly either at the sides or apex, beset with granules; spores olivaceous.

This genus was established by Fries in 1849 to accommodate a single species of wide distribution and somewhat varying habit, which is neither a tubifera nor yet a cribraria and offers points of resemblance to each. It is distinct in that the sporangia, while often in single series, are yet often superimposed. It resembles *Tubifera* in its simple sporangia, opening without the aid of a net; it is like *Cribraria* in the smooth ochraceous-olivaceous spores and granuliferous peridium.

1. LINDBLADIA EFFUSA *(Ehr.) Rost.*

PLATE I., Figs. 3, 3 *a*, PLATE XII., Figs. 1, 2.

1818. *Licea effusa* Ehr., *Sylv. Myc. Ber.*, p. 26.
1875. *Lindbladia effusa* (Ehr.) Rost., *Mon.*, p. 223.
1879. *Perichaena caespitosa* Peck., *Rep. N. Y. Mus.*, XXXI., p. 57.

Sporangia minute, either closely combined and superimposed, so as to form a pulvinate æthalium, or crowded together in a single layer, sessile, or short-stipitate; the peridia thin, membranous, marked by scattered plasmodic granules, often lustrous, sometimes dull lead-colored or blackish, especially above; stipe, when present, very short but distinct, brown, rugulose; hypothallus well developed, membranous, or more or less spongiose in structure; spore-mass ochraceous, under the lens, nearly smooth, almost colorless, 6–7.5 μ.

This very variable species has been well studied by Dr. Rex. See *Bot. Gaz.,* XVII., p. 201. In its simpler phases it presents but a single layer of sporangia generally closely crowded together, sometimes free and even short stipitate! In the more complex phase the sporangia are heaped together in a pulvinate mass in which the peridia appear as boundaries of minute cells. In this case the outermost sporangia are often consolidated to form a cortex more or less dense and shining. In any case the hypothallus is a prominent feature; generally laminated and of two or three layers, it is in the more hemispheric æthalia very much more complex, sponge-like. When thin this structure is remarkable for its wide extent, 40–50 cm.! The simpler forms approach very near to *Cribraria* through *C. argillacea.* The most complex remind us of *Enteridium.*

This is *Perichaena caespitosa* Peck. In this country it has, however, been generally distributed as *L. effusa* Ehr. This author throws some doubt on the species he describes by suggesting that the plasmodium may be *red.* The description, however, and figures are otherwise good and are established by the usage of Rostafinski. The plasmodium has much the same color as the mature fruit.

Widely distributed. New England to the Black Hills and Colorado, south to Arkansas. California, about Monterey.

2. Tubifera *Gmelin*

1791. *Tubifera* Gmelin, *Syst. Nat.,* II., p. 1472.

Sporangia tubular, by mutual pressure more or less prismatic, connate, pale ferruginous-brown, iridescent, the walls thin, slightly granular, long-persistent; dehiscence apical; hypothallus thick, spongiose, white or whitish; spore-mass ferruginous.

This genus is easily recognized by the tubular sporangia, destitute of capillitial threads, seated upon a strongly developed hypothallus. The synonymy of the case is somewhat difficult. It is possible that Mueller's *Tubulifera ceratum, Fl. Dan.,* Ellevte Haefte, 1775, p. 8, may belong here, but neither the text nor the figures make it certain. Neither he nor Œder, who gives us *T. cremor* in the same work, had any accurate idea of the objects described. Gmelin's description of *Tubifera,* II., 2, 1472, is, however, ample, and his citations of Bul-

liard's plates leave no doubt as to the forms he included. Gmelin writes: "Thecæ (membranæ expansæ superimpositæ) inter se connatæ seminibus nudiusculis repletæ."

Why, in face of so good a description, Persoon changed the name to that since current, *Tubulina,* is not clear.

Fries thinks Mueller had an immature *Arcyria* before him, *Syst. Myc.,* III., p. 196. *Tubulifera arachnoidea* Jacq., 1778, is also an uncertain quantity, insufficiently described.

Key to the Species of Tubifera

A. Hypothallus well developed, but not conspicuous.
  a. Pseudo-columellæ none . . . . . 1. *T. ferruginosa*
  b. Pseudo-columellæ present at least in many of the tubules, 2. *T. casparyi*
B. Hypothallus prominent, columnar . . . . . 3. *T. stipitata*

1. Tubifera ferruginosa *(Batsch) Macbr.*

Plate I., Fig. 4; Plate VII., Fig. 8; Plate XII., Fig. 14.

1786. *Stemonitis ferruginosa* Batsch, *Elench.,* p. 261, Fig. 175.
1791. *Sphaerocarpus cylindricus* Bull., *Champ.,* p. 140, t. 470, III.
1791. *Tubifera ferruginosa* Gmelin, *Syst. Nat.,* 1472 (*ex parte*).
1805. *Tubulina cylindrica* (Bull.) DC., *Fl. Fr.,* 671.
1875. *Tubulina cylindrica* (Bull.) Rost., *Mon.,* p. 220.
1894. *Tubulina fragiformis* (Pers.) Lister, *Mycetozoa,* p. 153.

Sporangia crowded, cylindric or prismatic, elongate, connate, more or less distinct above, pale umber-brown, generally simple though occasionally branched above, the peridia thin, sometimes fragile, but generally persistent, transparent, iridescent; hypothallus strongly developed, spongiose, white, often projecting beyond the æthalioid mass of sporangia; spore-mass umber-brown or ferruginous; spores by transmitted light almost colorless, plainly reticulate over three-fourths of the surface, 6–7 μ.

Not rare on old logs, mosses, etc., from Maine to Alaska. Apparently more common north than south. Easily known by its long, tubular sporangia packed with rusty spores and destitute of any trace of columella or capillitium, the hypothallus explanate, rather thick, but not columnar. A single plasmodium may give rise to one or several colonies, at first watery or white, then red, of somewhat varying

shades, then finally umber-brown. These colors were noticed by all the older authors, but very inaccurately; thus a white plasmodium is the basis for *Tubifera cylindrica* (Bull.) Gmel., a roseate plasmodium for *Tubifera fragiformis* (Bull.) Gmel., and the mature fructification for *Tubifera ferruginosa* (Batsch) Gmel. Rostafinski adopted a specific name given by Bulliard, but Batsch has clear priority.

The peridia are sometimes accuminate, and widely separate above. This is Persoon's *T. fragiformis*. In most cases, however, the peridia are connate throughout, and sometimes present above a membranous common covering. This is *T. fallax* of Persoon; *Licea cylindrica* (Bull.) Fries. In forms with thicker peridia, the walls often show the granular markings characteristic of the entire *Anemeae*.

2. TUBIFERA STIPITATA *(Berk. & Rav.) Macbr.*

1858. *Licea stipitata* Berk. & Rav., *Am. Acad.*, IV., p. 125.[1]
1868. *Licea stipitata* Berk. & Rav., *Jour. Linn. Soc.*, X., p. 350.
1875. *Tubulina stipitata* (Berk. & Rav.) Rost., p. 223.

Sporangia crowded in a globose or more or less hemispheric, expanded head, borne upon a spongy, stem-like, sulcate hypothallus 3–4 mm. high, their apices rounded, their walls very thin, evanescent; spores in mass umber-brown, small, about 5 μ, the epispore reticulate as in the preceding species.

This differs from number 1 chiefly in the cushion-like receptacle on which the crowded sporangia are borne, and in the smaller spores. The species originates in a plasmodium at first colorless, then white, followed by salmon or buff tints, which pass gradually into the dark brown of maturity. This peculiar succession of colors is perhaps more diagnostic than the difference in habit. The spores are, however, constantly smaller in all the specimens we have examined, and the stipitate habit very marked.

New England, New York, south to South Carolina, and west to South Dakota; our finest specimens are from Missouri.

3. TUBIFERA CASPARYI *(Rost.) Macbr.*

PLATE XII., Fig. 9.

1876. *Siphoptychium casparyi* Rost., *Mon. App.*, p. 32.

[1] For this citation we are indebted to *Mr. Hugo Bilgram.*

Sporangia closely crowded, tubular, cylindric or prismatic by mutual pressure, connate, the apices rounded, convex, covered by a continuous membrane, umber-brown; the peridia firm, persistent, minutely granular, iridescent; hypothallus well developed, thin, brown, explanate; pseudo-columellæ erect, rigid, traversing many of the sporangia, and in some instances bound back to the peridial walls by slender, membranous bands or threads, a pseudo-capillitium; spore-mass dark brown or umber, spores by transmitted light pale, globose, reticulate, 7.5–9 μ.

This is *Siphoptychium casparyi* Rost. In *Bot. Gaz.*, XV., p. 319, Dr. Rex shows that the relationships of the species are with *Tubifera;* that the so-called columella is probably an abortive sporangium, the so-called capillitial threads having no homology with the capillitial threads of the true columelliferous forms. It is a good species of *Tubifera,* nothing more. The tubules are shorter than in either of the preceding species; the spores are darker, larger, and more thoroughly reticulate.

The plasmodium is given by Dr. Rex, *l. c.,* as white, then "dull gray tinged with sienna color," then various tones of sienna-brown, to the dark umber of the mature æthalium.

New York, Adirondack Mountains; Allamakee Co., Iowa.

3. Alwisia *Berk. & Br.*

Plate XIX., Figs. 5 and 5 *a.*

1873. *Alwisia* Berk. & Br., *Jour. Linn. Soc.,* Vol. XIV., p. 86.

Sporangia ellipsoidal, clustered, stipitate; dehiscence by the falling away of the upper part of the peridium disclosing a persisting pencil of capillitial threads. A single species: —

1. Alwisia bombarda *Berk. & Br.*.

1873. *Alwisia bombarda* Berk. & Br., *Jour. Linn Soc.,* XIV., p. 86.

Sporangia gathered in clusters of four to eight, surmounting coalescent, or sometimes divergent stalks, rusty-brown, or pallid, the peridium evanescent above; the coalescing stalks forming, especially below, a clustered column, 2 mm. in height, equalling the sporangia, dull reddish-brown in color; capillitium of rigid, tubular, generally

simple threads, attaching above by delicate tips, below by a broader sometimes branching base, sometimes conjoined near the peridial wall, now and then at irregular intervals inflated slightly or anon bulbose, roughened by projecting spinules, one-third the diameter, brownish or yellow; spores reddish-brown, faintly marked by reticulating bands over large part of the surface, 5–5.5 μ.

This peculiar species looks at first very little like a myxomycete. The stiff projecting hairs of the capillitium are hyphal in appearance and under the lens recall the phycomycetes; but the spores and withal the general structure seem to claim recognition here. Rostafinski was inclined to make a trichia of it, because of the hair-like capillitium, and markings on the threads, Massee found indistinct spiral markings even, enough to suit at least the prototrichias. Mr. Lister would put it near the tubifers. Father Torrend thinks of the dianemas, margaritas, etc., because of simple capillitium attached above and below! Spore-characters are probably the index most reliable, and the partial reticulation suggests association with *Tubifera* and for the present it may find station there, as in the English monograph.

Rare. Collected three times: twice in Ceylon, once in Jamaica. By the courtesy of Dr. Farlow, late lamented, we record the western specimens.

D. RETICULARIACEÆ

Fructification æthalioid; the sporangia sometimes poorly defined, intricately associated, borne on a common hypothallus and covered above by a common cortex; the lateral walls variously perforate and incomplete, form a pseudo-capillitium; spores umber or ochraceous.

Key to the Genera of the Reticulariaceæ

A. Spores umber.
  a. Sporangia wholly indeterminate, their walls much consolidated below, fraying out above into long, slender threads, 1. RETICULARIA
  b. Sporangia bounded, more or less distinctly, by broad perforate plates throughout . . . . . 2. ENTERIDIUM
B. Spores ochraceous . . . . . 3. DICTYDIÆTHALIUM

1. Reticularia *(Bull.) Rost.*

1791. *Reticularia* Bulliard, *Champ. de la France,* p. 95, in part.
1873. *Reticularia* (Bulliard) Rost., *Versuch,* p. 6.

Plasmodium at first white, then pink, 'ashes of roses,' etc. Sporangia wholly indeterminate or undefined, their walls represented (?) by a spongy mass of so-called capillitium, consisting of membranous plates, branching, anastomosing, vanishing without order or symmetry, generally giving rise at the sides, and especially above, to long slender flexuous threads; outer cortex silvery white; hypothallus distinct, white; spore-mass and threads umber or rusty brown.

A single species, —

1. Reticularia lycoperdon *(Bull.) Rost.*

Plate X., Figs. 7, 7 *a*; Plate XII., Fig. 3.

1791. *Reticularia lycoperdon* Bull., *Champ. de la France,* p. 95.

Æthalium pulvinate, 2–8 cm. broad, at first silvery white, later less lustrous, the cortex irregularly and slowly deciduous; hypothallus at first conspicuous as a white margin extending round the entire aethalium, evanescent without, but persisting as a firm membrane beneath the spore-mass, pseudo-capillitium abundant, tending to form erect central masses which persist long after the greater part of the fruit has been scattered by the winds; spore-mass umber, spores by transmitted light pale, reticulate over about two-thirds of the surface, the remainder slightly warted, 8–9 μ.

Not common. Often confused with the following, the spores of the two forms being very much alike; the internal structure, entirely different, and once compared, the two are thereafter easily distinguished at sight by external characters. The sporangial make-up is indifferent, confused. It represents a phase in development whence might issue columellæ with capillitium-branches or distinct tubular sporangia with persisting walls; or are such structures here but reminiscent only? Compare *Amaurochaete atra,* where similar conditions prevail. There differentiation goes on to the formation of a structure of which *Stemonitis* is type; here the sporangium-wall becomes dominant; suffers modification for spore-disposal, an idea reaching fair expression in *Cribraria* and *Dictydium.*

The plasmodium is white, noted Bulliard. Fries cites with approval the words of Schweinitz,—"color corticis ab initio argenteus

sericeo nitore insignis; sed deinde sordescit e griseo in subfuscum vergens." Sometimes the surface does indeed shine as silver!

The fructification appears to be isolated in each case; the entire plasmodium consumed in a single plasmodiocarp.

Widely distributed. Maine to California, and south.

2. Enteridium *Ehrenberg*

1818. *Enteridium* Ehrenberg, Link and Spreng., *Jahrb., Bd.* II., p. 55.

Fructification æthalioid; the confluent sporangia inextricably interwoven, the walls perforate by large openings, the resultant network of broad plates and bands widening at the points of intersection.

The genus *Enteridium* is distinguished from *Reticularia* chiefly by the more perfectly developed sporangial walls. These are everywhere membranous and do not show the abundant filiform dissipation so characteristic of *Reticularia.* The resultant structure in *Reticularia* is a mass of more or less lengthened and anastomosing threads; in *Enteridium,* an exceedingly delicate but sufficiently persistent sponge. The "net-like, three-winged skeleton" referred to by Rostafinski results from the union at one point of three adjoining sporangia. Compare the section of the adjoining cells of a honeycomb.

Of this genus there are but two or three species, all so far occurring in our territory.

Key to the Species of Enteridium

A.	Fructification umber brown	1 *E. splendens*
B.	Fructification olivaceous	2. *E. olivaceum*
C.	Fructification minute, 1–2 mm.	3. *E. minutum*

1. Enteridium splendens *Morg.*

Plate I., Figs. 1, 1 *a*, 1 *b*; Plate XII., Figs. 4, 5.

1876. *Reticularia* (?) *rozeanum* Rost., *Mon. App.,* p. 33.
1889. *Enteridium rozeanum* (Rost.) Wing., *Proc. Phil. Acad.,* p. 156.
1892. *Enteridium rozeanum* Wingate, Macbr., *Bull. Lab. Nat. Hist. Iowa,* II., p. 117.
1893. *Reticularia splendens* Morg., *Jour. Cin. Soc.,* p. 11.
1899. *Enteridium splendens* Morg., Morg. *in litt.*

Æthalium pulvinate, even, or somewhat irregular, unevenly swollen

or inflated, lobate or compound, covered by an exceedingly thin, generally smooth, shining, but never white, pellicle or cortex, brown, from 1–6 cm. in diameter; hypothallus white, often wide extending; capillitium none; the sporangial walls thin and brown forming a network as above described; spore-mass umber, spores by transmitted light pale, about two-thirds of the surface reticulate, the rest nearly smooth, 7–9 μ.

Very common, especially west, on decaying logs and stumps of every description. Easily distinguished by its brown color and smooth, shining, though uneven surface. The plasmodium as it emerges to form fruit is pale pink or flesh color, slowly deepening to brown as maturity advances. The first emergence is a watery white.

New England, Canada, to Minnesota and Nebraska, South Dakota.

In 1876 Rostafinski provisionally referred to the genus *Reticularia* certain specimens received from M. Roze of Paris. Thirteen years later in correspondence with M. Roze, Mr. Wingate satisfied himself that the specimens discovered by Roze were the same as our common enteridium. He therefore, *l. c.,* applied to our American forms the name they have widely borne, *E. rozeanum.* Mr. Lister, *Jour. of Botany,* Sept. '91, applied the Rostafinskian name to ertain English specimens. Thereafter to be known as *Reticularia lobata* Rost. and so fixed the status of that species. From all the literature before us it appears that Mr. Lister was right. *R. lobata* List. (now *Liceopsis lobata* (List.) Torr., occurs in various parts of Europe, while our American species of *Enteridium* is yet to be discovered on that side of the sea!

Were the latter native to the old world at all, it had surely been seen long ago. It is large and fine, and could not have escaped the famous collectors of the last two hundred years. Although it has been sent by students from this side of the ocean to Europe for more than thirty years, it has not even adventitiously appeared.

It therefore appears that our American species is known to Europe through Mr. Wingate's reference only.

Twenty years ago in correspondence with Mr. Wingate it was learned that the material received by him from M. Roze was but

a small fragment, crushed flat, and even this was at that time no longer in evidence. This specimen was itself *not part of the gathering submitted to Rostafinski;* but only the fragment of something *appearing in* 1890 *in the same locality!*

> . . . . "something not the same,
> But only like its forecast in men's dreams."

When we further reflect that the spores of species of several of the forms now in review, *Tubifera, Reticularia, Enteridium,* are not without difficulty distinguished, it is easy to see that Mr. Wingate's specific reference has narrow foundations to say the least. It seems now likely that Father Torrend's *Liceopsis, Reticulara lobata* R., M. Roze's aftermath, and all, are but the depauperate forms of some tubifera!

E. rozeanum Wing., is therefore the synonym for an ill-defined something in Western Europe and need not further here concern us as far material reference goes.

In any case, what induced Mr. Wingate to pull Rostafinski's uncertain description of a problematic form across the sea, to attach it to our clearly defined and well known American species, changing the Polish description the while to make it fit, is hard to understand; especially in view of the fact, by Wingate admitted, that Rex had in his letters to Morgan already named the American type *Enteridium umbrinum.* The two students differed as to generic reference, and later on Morgan published *Reticularia splendens* Morg.; rather than *R. umbrina* (Rex) Morg. because he was using *R. umbrina* Fr. for what is generally known as *R. lycoperdon* (*Bull.*)

It would then appear that when Wingate sought to impose the Rostafinskian specific name upon our American form by changing (fixing!) Rostafinski's generic reference, and by re-writing the specific description from the pages of the *Monograph* in order to claim identity, he was entirely without justification, especially since he knew the species appropriately named by his colleague, Dr. Rex, and had the name as used in the Rex and Morgan correspondence.

In brief; Mr. Wingate proceeded to re-describe Rostafinski's rozean specimen and referred a long-known American form (very different) to the European specimen as type. Wingate's description is right;

he had the American material before him; but his cited type is worthless, an entirely different thing.

Does the reader care to see what the European *type* of our common form, Wingate *teste,* really looks like, let him consult the *Jour. of Botany,* Vol. XXIX., p. 263, 1891.

2. Enteridium olivaceum *Ehr.*

1818. ***Enteridium olivaceum*** Ehr.

Æthalium depressed flat, oval or elongate, .3 cm. in extent, .6 mm. thick when fresh, glossy, smooth, greenish-olivaceous-brown; within a spongy net-work representing sporangial walls which are thin, pale olivaceous, perforate by circular openings, meshes surrounded by wide plates; spores in clusters, six or more together, ovoid, distinctly warted at the wider end, pale olivaceous, 9–11 μ.

This, the type of the genus, is a very distinct species of this by its structure readily distinguished form. Fries thought the species might represent a less perfectly-developed reticularia, and therefore wrote *Reticularia olivacea* noting, however, the clustered spores and the lack of hypothallus.

Common, as would appear, in Europe and in S. America; rare with us. Reported from N. Hampshire and we have one specimen from Colorado.

3. Enteridium minutum *Sturg.*

1917. ***Enteridium minutum*** Sturg., *Mycologia,* IX, p. 328.

Æthalia rounded or elongate, pulvinate, pale umber in color, seated on a broad membranous base, 1.5-2 mm. in diameter; wall wrinkled and usually marked with small scattered pits, pale-yellow, membranous; walls of component sporangia, membranous, minutely roughened, perforated with round openings, the margins of which show many free threads; or reduced to irregular, anastomosing strands arising from the base of the æthalium, with membranous or net-like expansions at the angles and with many delicate, free, pointed ends. Spores pale-yellow, usually united in twos or threes,

and ovoid or flattened on one side; when free, globose, very minutely spinulose, 9.5-10.5.

Colorado: *Dr. Sturgis.*

3. Dictydiæthalium *Rostafinski*

1873. *Dictydiaethalium* Rost., *Versuch,* p. 5.
1875. *Clathroptychium* Rost., *Mon.,* p. 224.

Æthalium depressed, flat; the sporangia erect, regular, prismatic by mutual pressure, the peridia convex above, wanting at the sides and within the æthalium represented by vertical threads marking the angles and passing from base to summit.

This genus is readily recognized by the internal structure of the æthalium. The lateral wall-openings, which, as we have seen, characterize the sporangia of the preceding genus, here become extreme, occupying to such extent the lateral wall-space of each sporangium that only threads remain to mark the vertical angles.

In 1873 Rostafinski applied the generic name here adopted, because he thought he discovered close relationships with *Dictydium.* In 1875, believing his first impressions erroneous, and desirous that the nomenclature might not at once mislead the student and perpetuate the memory of his own mistake, the same author proposed the name by which the genus has generally ever since been known—*Clathroptychium.* However sensible the latter conclusion reached by our Polish author, it is plainly contrary to all rules of priority.

Our region shows but a single widely distributed species,—

1. Dictydiæthalium plumbeum (*Schum.*) *Rost.*

Plate I., Figs. 2, 2 *a*, 2 *b*.

1803. *Fuligo plumbea* Schum., *Enum. Saell.,* No. 1410.
1833. *Licea rugulosa* Wall., *Cr. Fl. Ger.,* IV., p. 345
1873. *Dictydiaethalium plumbeum* (Schum.) *Rost., Versuch,* p. 5.
1875. *Clathroptychium rugulosum* (Wallr.) Rost., *Mon.,* p. 225.
1894. *Dictydiaethalium plumbeum* Rost., List., *Mycetozoa,* p. 157.

Æthalium thin, very flat, olivaceous or ochraceous, smooth, under the lens punctate, in section showing the columnar or prismatic sporangia, which are normally six-sided, having at the edges six simple

threads, the remains of peridium, extending from base to apex, where the peridium remains intact, arcuate; hypothallus prominent, radiating far around the æthalium, silvery white; spores in mass, ochraceous, or dull brownish yellow, by transmitted light almost colorless, rough 9–10 μ.

Not rare, on decaying logs, especially of *Tilia americana,* where in the same place successive fructifications follow each other sometimes for weeks together in the latter part of summer and early fall. The æthalium is generally elliptical or elongate, 2–3 cm. in extent, sometimes irregular or branched, varying in color according to degree of maturity, weathering, etc. Plasmodium at first watery, then pink, or flesh-colored.

Eastern United States; common. Toronto;—*Miss Currie.*

E. CRIBRARIACEÆ

Sporangia distinct, more or less closely gregarious, stipitate, the peridium opening, especially above, by a well-defined network formed from thickenings in the original sporangial wall.

Key to the Genera of the Cribrariaceæ

A. Peridial thickenings in form of an apical net with definite thickenings at the intersections of the component threads . . 1. CRIBRARIA
B. Peridial thickenings in form of parallel meridional ribs connected by delicate transverse threads . . . . . 2. DICTYDIUM

Cribraria (*Pers*) *Schrader.*

1794. *Cribraria* Persoon, Römer, *N. Bot. Mag.,* I., p. 91, in part.
1797. *Cribraria* Schrader, *Nov. Gen. Plant.,* p. 1, in part.
1875. *Cribraria* Rostafinski, *Mon.,* p. 229.

Sporangia distinct, gregarious or closely crowded, globose or obovoid, stipitate; the stipe of very varying length; the peridium simple, marked within by distinct and peculiar, granular, thickenings, which below take the form of radiating ribs, supporting the persisting cup, *calyculus,* and above, by extremely delicate anastomosing branches, unite to weave a more or less regular net with open polygonal meshes; spores various, more often yellowish or ochraceous, sometimes brown, reddish, or purple.

The genus *Cribraria,* as limited by Persoon, included all forms in which the peridium is thin, evanescent half-way down, or entirely, and in which capillitium, as Persoon regarded the case, is formed of a network of reticulate threads surrounding the spores. Schrader re-defined the genus; opposed Persoon's view as to the capillitial nature of the net, and separated the genus *Dictydium,* but by imperfect limitations, — in fact, chiefly because of the more completely evanescent peridium. Fries follows Schrader. Rostafinski first clearly separated the two genera, and his classification is here adopted. Nevertheless, after reviewing the subject entire one is more and more inclined to appreciate the commendation of Fries; "Auctor Schrader, qui insuper plurimas species detexit, et hoc et sequens genus ita proposuit ut sequentes vix aliquid addere valuerint."

As to the habitat of the cribrarias, the remark of Schrader is still pertinent —"in vetustissimis plenariæ destructionis proximis arborum truncis"—for all the species. Rotten, coniferous wood seems to be preferred, but the decayed logs of trees of other orders are by no means refused. Rotten oak forms a very common habitat.

Key to the Species of Cribraria

A. Sporangia with spores ochraceous or brownish.
- *a.* Sporangia larger, .5 mm. or more.
  - 1. Net poorly developed, sometimes merely indicated, 1. *C. argillacea*
  - 2. Net conspicuous, nodes expanded, not swollen.
    - i. Calyculus reticulately thickened, ill-defined above, 2. *C. macrocarpa*
    - ii. Calyculus with radiant lines or ribs; net small-meshed; free ends none . 6. *C. aurantiaca*
    - iii. Net wide-meshed, calyx rufous . 4. *C. rufa*
    - iv. Calyx replaced by ribs . . 5. *C. splendens*
  - 3. Net conspicuous, nodules swollen.
    - i. Net-threads simple; free ends many 7. *C. dictydioides*
    - ii. Net-threads often parallel in twos or threes, 8. *C. intricata*
- *b.* Sporangia small, less than .5 mm.
  - 1. Nodes not expanded . . . 3. *C. minutissima*
  - 2. Nodes well shown.
    - i. Calyculus distinctly marked by radiant lines, nodes round . . . . . 10. *C. tenella*

ii. Calyculus minute or none; nodes prominent, 11. *C. microcarpa*

B. Sporangia more or less marked with purple or violet tints.

a. Purple or violet throughout.

1. Net poorly developed . . . . 12. *C. violacea*
2. Net well developed.
   i. Meshes regular and the nodes distinct, 14. *C. elegans*
   ii. Meshes and nodules irregular . 13. *C. purpurea*

b. Purple tints confined chiefly to plasmodic granules on the calcyulus and stipe.

Net with nodes well expanded.

i. Stipe short, not more than double the sporangium; net and calyculus both well developed 9. *C. piriformis*
ii. Stipe many times the sporangium, weak, 15. *C. languescens*
iii. Stipe slender, sporangium copper-colored, 16. *C. cuprea*

1. Cribraria argillacea *Pers.*

Plate XII., Figs. 12, 13; Plate XVII., Fig. 1.

1791. *Stemonitis argillacea* (Pers.) Gmel., *Syst. Nat.*, II., 1469.
1796. *Cribraria argillacea* Pers., *Obs. Myc.*, I., p. 90.

Sporangia dull ochraceous-olivaceous, globose, nearly 1 mm. in diameter, sessile or short stipitate, closely gregarious or crowded, the peridial walls at maturity smooth, shining, except above, long persistent, obscurely reticulate, with irregular thickenings which at the apex at length present the appearance of an irregular, coarsely meshed net without nodal thickenings; stipe very short, stout, erect, reddish brown, spore-mass ochraceous, spores by transmitted light pale, spinulose, 5–6 μ.

This species stands just on the border-line between the tubiferas and the genus now before us. While on the one hand it possesses many characters such as the habit, form of sporangium, which are distinctly tubuline, on the other it shows in the upper peridial wall definite reticulations which suggest *Cribraria*. In freshly formed sporangia the reticulations are barely visible in the crown; later on they are more manifest, until, as spore-dispersal proceeds; the cribraria characters come out with sufficient distinctness, and in empty sporangia the reticulations may be seen to affect the entire peridial wall. The

nodes are not expanded. The spores are pale by transmitted light, spinulose, about 6 μ. Plasmodium lead-colored. Found sometimes in large patches on rotten logs of various species. Not uncommon. Cf. *Lindbladia effusa.*

New England, New York, Pennsylvania, South Carolina, Ohio, Illinois, Iowa, Washington; Canada.

2. Cribraria macrocarpa *Schrader.*

Plate XVII., Fig. 2.

1797. *Cribraria macrocarpa* Schrad., *Nov. Gen. Plant.,* p. 8.

Sporangia more or less closely gregarious, yellowish brown, pear-shaped or obovate, large, .8–1 mm. in diameter, stipitate; stipe brown furrowed, erect or often nodding, about equal to the sporangium or longer; calyculus distinct, marked by numerous dark brown radiating ribs, iridescent, perforate above, deeply dentate, and merging gradually into the elegant network, of which the dark nodes are more distinctly expanded about half way up, less so at the apex and below, the filaments exceedingly delicate, simple, with occasional free ends projecting into the small meshes; spore-mass yellowish, spores by transmitted light almost colorless, minutely roughened, 5–6 μ.

Perhaps the most striking characteristic of the present species, aside from its large size, is the peculiarly perforated cup or calyculus. Schrader's artist failed him here completely. The structure is exceedingly delicate, the peridium between the ribs and reticulations reduced to the last degree of tenuity, with the iridescence of the soap-bubble, here and there lapsed entirely. Withal the structure seems firm enough and persists until all the spores are dissipated by the wind.

Easily distinguished from the preceding, its only rival in size, by the obovate or turbinate, netted sporangium, its much longer stem, and flat, perfectly formed nodes.

Rare. New York, North Carolina, South Carolina, Oregon; Toronto, Canada.

3. Cribraria minutissima *Schweinitz.*

Plate XVII., Figs. 6, 6 *a.*

1832. *Cribraria minutissima* Schw., *N. A. F.*, No. 2362.

Sporangia scattered, orange or nut-brown, very minute, .1–.3 mm. or less, globose or ellipsoidal, stipitate, erect or nodding; hypothallus none; stipe short, 1–3 times the sporangium, filiform, tapering upward, brown; the calyculus variable, sometimes well marked and separated from the net when fully mature, by a shallow constriction, more commonly small or entirely wanting, especially in the spherical sporangia; net simple, large meshed, without nodal expansions, the threads flattened; spore-mass yellow, spores by transmitted light, pale, nearly smooth, 5–6 μ.

A most beautiful tiny species. Generally in all the specimens before us, a perfect, spherical net, firm enough to retain its place and structure after all the spores have been scattered. When mature the spore-mass seems to roll about as a ball, freely within the net, the spores being thus gradually dispersed. The calyculus when present is without veins. *C. minima* Berk. & C., and *C. microscopica* Berk. & C. are doubtless the same thing. *Grev.*, II., p. 67, 1823. See also *Bot. Gaz.*, XIX., 397.

Rare. Pennsylvania, South Carolina, Missouri, Iowa; Black Hills, South Dakota.

4. Cribraria rufa (*Roth*) *Rost.*

Plate XIX., Fig. 8.

1788. *Stemonitis rufa* Roth, *Fl. Germ.*, I., p. 548.
1794. *Cribraria rufescens* Pers., Rœmer, *N. Mag. Bot.*, I., p. 91.
1797. *Cribraria fulva* Schrad., *Nov. Gen. Pl.*, p. 5.

Sporangia scattered, subglobose or turbinate, dark or reddish orange, .5–.7 mm. in diameter, erect, stipitate; stipe about equalling the height of the sporangium or longer, dark brown or black; calyculus one-third to one-half the sporangium, the margin toothed, the wall ribbed and continuous with the open wide-meshed net; the network deep yellow or orange, the threads flattened; the nodes not thickened, little differentiated; spores concolorous, by transmitted light, pale yellow, verruculose, 5–7 μ.

Similar to the preceding, but generally much larger and not so much inclined to brown. The size, however, is extremely variable in sporangia from the same plasmodium (reported white), some no larger than those of the species reckoned most minute.

Oregon. *Professor Morton Peck.*

5. CRIBRARIA SPLENDENS (*Schrader*) *Rost.*

PLATE XIX., Fig. 10.

1797. *Dictydium splendens* Schrad., *Nov. Gen.*, p. 14.
1801. *Cribraria splendens* (Schrad.) Pers., *Syn. Fung.*, p. 191.

Sporangia gregarious, globose, dusky yellow when filled with spores, dull or dusky brown when these are discharged, stipitate; stipe long, 3–4 times the sporangium, subulate, erect-nodding, brown; hypothallus none; network brown, with large meshes, imperfectly defined nodes and flattened threads; calyculus none, its place supplied by nine or ten distinct, firm ribs which radiate from the stipe and support the net, branching to blend with its reticulations; spore-mass yellow, spores by transmitted light, colorless, smooth or nearly so, 6–7.5 μ.

Of this species two specimens only are before us, one from Muscatine County, Iowa, and one from Washington (state). The species seems thus to have wide range, but to be exceedingly rare. It differs from all other American forms, so far described, in the peculiar development of the calyculus. Rostafinski emphasizes the persistence of the peridial wall and the peculiar gleaming of the metallic tints, displayed by all the structures. These particulars we have not been able to verify. Such characters may be incident to age or conditions of development. At all events, in forms which in all other respects seem to agree exactly with Rostafinski's descriptions, the colors are dull and without any noticeable iridescence. The spores in our specimens are also a little larger than quoted. Rostafinski gives 5–6 μ; Massee, 5–7 μ.

6. CRIBRARIA AURANTIACA *Schrader.*

PLATE XVII., Fig. 3, and XIX., Fig. 7.

1797. *Cribraria aurantiaca* Schrad., *Nov. Gen. Pl.*, p. 5.

Sporangia gregarious, spherical, dusky or yellowish stipitate, nod-

ding; the calyculus variable, generally prominent, more or less distinctly marked by fine, delicate radiating venules, the margin denticulate, the teeth numerous and slender, supporting the well-defined globose net; network made up of very tenuous threads, forming rather small irregular brownish nodules and showing only here and there a free extremity; stipe generally short, two or three times the diameter of the sporangium, sometimes longer, tapering upward, brown, slender, arcuate above; spore-mass yellow or ochraceous, spores by transmitted light, colorless, 5–6 μ, almost smooth.

This widely distributed and very variable species is generally recognized by the large sporangia, .5–.9 mm., comparatively short stipe, simple net, and more or less orange color. The color is an uncertain thing even in the sporangia, which rise from one plasmodium. Schrader, however, made this feature so far diagnostic that he placed the more pronouncedly yellow forms in the species *C. aurantiaca* and set off as *C. vulgaris* forms in which more dusky tints prevail. The dark-colored forms have also usually longer stipes, but so much is dependent upon the climatic conditions prevalent at the time of fruiting, that this feature also is indeterminate. Rostafinski's figures, 21 and 26, Tab. II., show the characteristic nodules and the typical net structure. It is to be observed that Fig. 21 represents higher magnification; otherwise the two figures are very much alike.

New England, New York, Pennsylvania, Maryland and South, Ohio, Washington, California; Canada, Toronto.

7. Cribraria dictydioides *Cke. & Balf.*.

Plate I., Figs. 5, 5 *a*, 5 *b*, and XIX., 6, 6 *a*, 6 *b*.

1881. *Cribraria dictydioides* Cke. & Balf., *Rav. Fung. Am.*, 475.

Sporangia gregarious, of medium size, globose, cernuous, stipitate; the stipe long, slender, tapering upwards, dull brown in color; hypothallus none; the calyculus variable, sometimes well developed, as in *C. aurantiaca,* sometimes rudimentary or represented only by irregular, node-like ribs; the network delicate, the meshes small, few-sided; the nodules large, prominent, brown, irregular, with several radiating, free, projecting threads, beside the single continuous filaments

which pass from node to node; spore-mass pale, ochraceous; spores nearly smooth, colorless, 5–7 μ.

This seems to be the most common *Cribraria* in the Mississippi valley. It is generally distinguished by the scant calyculus and the beautiful richness of its clear delicate net. The stellate nodules especially above, emit filamental rays in all directions, but are, notwithstanding, united by single, unpaired threads only. The calyculus is often entirely absent, and this has been supposed the typical condition; but, on the contrary, there often may present itself a cup as distinct as in *C. aurantiaca*. See, for this variation, *Bot. Gaz.* XIX., p. 398. The rather large sporangia, .6–.7 mm., the nodes joined by single threads, the remaining radiant threads, many or few, but very short—these seem to be the most distinctly diagnostic characters, and these are sufficiently constant to separate this species easily from *C. intricata* on the one hand and *C. tenella* on the other. Mr. Lister considers this merely a form of the next species.

Abundant on rotten logs of every sort, especially oak; common on the lower side of rotting pine planks in wooden walks along the streets everywhere. N. A. F., 2095, seems to belong here.

Pennsylvania, Ohio, North Carolina, Missouri, Illinois, Iowa, Nebraska.

8. CRIBRARIA INTRICATA (*Schrad.*) *Rost.*

1797. *Cribraria intricata* Schrad., *Nov. Gen. Pl.*, p. 7.

Sporangia gregarious, globose, large, .7–1 mm. in diameter, nut-brown or olivaceous, erect, stipitate; stipe long, slender, purplish brown, flexuous; calyculus variable, sometimes occupying one-third of the sphere, when it is delicately costate, concolorous with the stipe, and passes over to the net by a distinctly toothed or serrulate margin, sometimes represented by irregular ribs or costæ only; net well differentiated, the threads delicate, transparent, yellow, connecting large black nodules, running from one to the other in pairs or sometimes three together, free ends not numerous, the meshes few-sided, often triangular; spores in mass, dull olivaceous, under the lens pallid, nearly smooth, 6–7 μ.

A very rare species, if indeed it occur in this country. At least

the form figured by Rostafinski, Tab. II., Fig. 27, and Massee, Pl. 1, Fig. 11, has not come to our notice. The parallelism of the net threads is a touch added by Rostafinski; Schrader does not mention it. Lister makes this species include the preceding. The form described in *Bull. Lab. Nat. Hist. Ia.* II., p. 119, is *C. dictydioides.*

Reported from New York, New England and Pennsylvania.

In the English *Monograph* we are repeatedly assured that this species is common in the United States. The statement is made possible only by the inclusion of the form originally described from America and truly abundant east of the Rocky Mountains, *C. dictydioides* Cke. & Balf.; *C. intricata,* by all accounts, just as preeminently the species of Europe. It is true that Schrader did not emphasize the parallel connecting threads by which later authorities distinguish the form; he had little occasion so to do, even did his figures intend accuracy in each detail, which they did not, and Rostafinski's, though his drawing is a diagram, certainly knew what he was doing. Cooke, in his list for Great Britain, quotes the Polish text without dissent, and Massee follows and illustrates; so that there can be no doubt as to what the European species is.

In any cribraria the presence or relative obsolesence, of the calyculus is of little taxonomic import since that structure is variable in every species. In the latest edition of Mr. Lister's work, the American form is entered as a variety in "hot-houses"; apparently adventitious; it is indeed related to the European form but is a geographic species.

9. Cribraria piriformis *Schrader.*

Plate XVII., Fig. 9; Plate XIX., Fig. 9.

1797. *Cribraria piriformis* Schrad., *Nov. Gen. Pl.,* p. 4.

Sporangia gregarious, small, .3–.5 mm., turbinate or globose, erect, purplish brown, stipitate; stipe comparatively short, tapering upward, longitudinally furrowed, purple or brown; calyculus very well defined, about one-third the sporangium, not ribbed, flattened or even umbilicate below, the margin plainly denticulate, dusky brown; the net simple, the meshes large, triangular, with few free ends; the

nodules small, globose or undifferentiated, slightly convex or flat; spore mass dull, yellowish brown; spores by transmitted light pale ochraceous or salmon-tinted, nearly smooth, 5–6 μ.

Schrader defined this beautiful form chiefly by its shape. This, though variable, is yet generally so far pyriform as to show distinct contraction toward the stipe. The well-defined calyculus is narrowed below and eroded or denticulate above. The cyanic tints due to the presence on the calyculus of radiating lines of purplish granules about one-half the size of the spores, the net open, uniform, the stipe rather stout, short, and distinctly furrowed, rising often from a small hypothallus—these are marks of this species. The net suggests *C. tenella,* but the latter species is much smaller, has a different stem, much longer and unfurrowed. The cup here is more nearly that of some form of *C. intricata,* but is better defined, passing into the net very abruptly by the simple intervention of projecting teeth.

Apparently rare. Our specimens are from New York, through the courtesy of Dr. Rex, Virginia, North Carolina, Iowa, Oregon, Colorado, and represent, as usual a modification of the European type, *C. notabilis* Rex. Miss Lister, *Mon., 2nd ed.,* writes var. *notabilis.*

Colorado forms are remarkable for dense brown coloration.

10. Cribraria tenella *Schrader.*

Plate XVII., Fig. 5.

1797. *Cribraria tenella* Schrad., *Nov. Gen. Pl.,* p. 6.

Sporangia gregarious, small, .3–.5 mm. in diameter or smaller, olivaceous or ochraceous, long-stipitate, nodding; stipe slender, dark brown or blackish, very long, reaching 6 mm., weak and flexuous; calyculus variable, sometimes well defined, brown, costate, sometimes represented by the costæ only connected by a thin, transparent membrane; net well differentiated, the meshes small, irregular, the nodes small, black, more or less globular, prominent, connected by transparent threads with occasional or a few free ends; spores in mass, olivaceous-ochraceous, under the lens pallid, globose, smooth, 5–7 μ.

Very common eastward and south, on the weathered surface of rotten wood. Generally easily recognized by its very long stipe,

small, globose sporangium dotted with numerous small roundish nodules projecting plainly above the general surface. The obconic calyculus is always represented in the outline if not in definite structure.

New England, New York, Pennsylvania, Ohio, Tennessee, Illinois, Missouri, Iowa, Canada; Toronto,—*Miss Currie.*

11. Cribraria microcarpa (*Schrad.*) *Persoon.*

Plate XVII., Fig. 4.

1797. *Dictydium microcarpum* Schrad., *Nov. Gen. Pl.*, p. 13.
1801. *Cribraria microcarpa* Schrad., Pers., *Syn.*, p. 190.
1875. *Cribraria microcarpa* (Schrad.) Rost., *Mon.*, p. 235.
1892. *Cribraria microcarpa* Schrad., Massee, *Mon.*, p. 63.
1893. *Cribraria microcarpa* Schrad., Morg., *Myx. Mi. Vall.*, p. 15.
1899. *Cribraria microcarpa* Schrad., Macbr., *N. A. S.*, p. 168.
1911. *Cribraria microcarpa* Pers., Lister, *Mycetozoa, 2nd ed.*, p. 183 (?).

Sporangia loosely gregarious, very small, .2–.3 mm. in diameter, yellow ochraceous, stipitate, nodding; stipe comparatively stout, dark brown or blackish, tapering upward, often twisted at the apex as in *D. cancellatum;* calyculus none, represented by simple ribs which give off at intervals free or floating branchlets before blending into the common net; net well developed, the meshes large, the nodes small, irregular, though often rounded and prominent, black, connected by delicate transparent threads, with free ends few or none; spore-mass yellow, fading to ochraceous; spores pale, smooth, globose, 6–7 μ.

This species resembles at first sight the preceding, and has been often mistaken for it. As a matter of fact, the distinctions are generally very sharp. In the first place, the sporangia, when carefully measured, are seen to be not more than half as great in diameter; the meshes of the net, on the other hand, are much wider, the whole structure more compact. The nodules are like those of *tenella,* but are much fewer. The stipe is shorter, the cup wanting, and the costæ are few and simple. The color suggests *C. aurantiaca.* The habitat and distribution as *C. tenella.*

To anyone who will read the account of the species as given by the English *Mon., 2nd ed.,* p. 183, it is immediately apparent that

the author has in mind a different form from that seen and described in our territory and previously noted by the authors of Europe. These from Schrader down, agree in portraying a brunescent form with yellow spores; Mr. Lister enters it with the cyanic series and so describes and figures it throughout. Schrader figures a nut-brown species; Rostafinski uses that descriptive term in connection with the general appearance when fresh, but gives the spore-mass yellow; only in the stipe does he find another tint, nut-brown-purple. The figure, 145 in the *Monograph* now before us portrays, except in color, our *C. tenella* exactly. Dr. Rex, *Bot. Gaz.,* XIX., 398, compares the present species with *C. minutissima,* and *C. tenella* with *C. dictydioides;* which is correct for the American presentation of the species named. *C. dictydioides* is certainly our presentation of *C. intricata,* a geographic species at the least; but if *C. microcarpa* is purple we have of it no representation; our forms under that name are closely related to *C. tenella,* a yellow-spored species, and might perhaps be there referred; have, however, somewhat larger spores.

12. Cribraria violacea *Rex.*

Plate XVII., Fig. 8.

1891. ***Cribraria violacea*** Rex, ***Proc. Phil. Acad.,*** p. 393.

Sporangia scattered or gregarious, very small, .2 mm. in diameter, violet tinted, erect, stipitate short, about one-half the total height, concolorous, slender, tapering upward; calyculus crateriform, persistent, or marked with minute plasmodic granules; the net rudimentary or poorly developed, the meshes large, irregular, the nodules also large triangular, violaceous; spores pale violet in mass, by transmitted light reddish, 7–8 μ, minutely warted.

A very minute but well-marked species discovered by Dr. Rex in Wissahickon Park, near Philadelphia, otherwise very rare. Lister, however, reports it from England. In minuteness to be compared with *C. minutissima,* from which its color instantly distinguishes it. Dr. Rex reports the plasmodium as "violet black." All our specimens are on very rotten wood, basswood, *Tilia americana.*

Pennsylvania, Illinois, Iowa.

13. Cribraria purpurea *Schrad.*

1797. *Cribraria purpurea* Schrad., *Nov. Gen. Pl.*, p. 8.

Sporangia gregarious, large, 1 mm. in diameter, dark purple, erect, stipitate, depressed-globose; stipe concolorous, furrowed, about twice the diameter of the sporangium in length, with a distinct hypothallus; calyculus persistent, less than half the sporangium, obscurely ribbed, marked by concentric plications, the margin toothed; the net poorly differentiated, the meshes irregular in form and size, as are also the flat, unthickened nodes, the threads pale, free ends short and not numerous; spore-mass purple; spores by transmitted light, pale or colorless, 5–6, μ, smooth.

Rare. Found on rotten coniferous wood in deep forests. Easily recognized by its large size and uniform purple color. To the next species it offers a general resemblance, but has larger sporangia and an entirely different net. The plasmodium just before the formation of the fruit is scarlet.

Maine, New York, Pennsylvania, Ontario, Oregon, Colorado.

14. Cribraria elegans *Berk. & C.*

1873. *Cribraria elegans* Berk. & Curt., *Grev.*, II., p. 67.

Sporangia gregarious, erect or nodding, small, .4–.5 mm., bright purple, stipitate; stipe long, slender, tapering upward, almost black, arising from a scanty hypothallus; calyculus about half the sporangium, finely ribbed, covered especially above with small purple granules, the margin toothed or perforate; net well developed, the meshes small, polygonal, the threads delicate, colorless, with many free ends, the nodules dark-colored, numerous and somewhat prominent; spore-mass pale purple; spores by transmitted light pale violaceous, smooth, 6–6.5 μ.

To be compared with the preceding. The small-meshed net with well-defined, dark-colored nodules is distinctive, aside from the fact of the much smaller sporangia. The stipe is also different, more slender, smooth, and dark-colored. The habitat of the two species appears to be the same. The present species is much more common, ranges farther west, and is to be looked for on the Pacific coast.

New York, Pennsylvania, South Carolina, Missouri, Iowa; Black Hills, South Dakota.

15. CRIBRARIA LANGUESCENS *Rex.*

1891. *Cribraria languescens* Rex, *Proc. Phil. Acad.*, p. 394.

Sporangia scattered, very minute, .25–.35 mm., spherical, long-stipitate, drooping; stipe 2.5–3 mm., slender, flexuous, subulate, rugulose; calyculus about one-third the sporangium, reddish brown, shining, minutely striate with granular lines, the margin more or less regularly serrate; net reddish brown, the meshes triangular and the threads simple, the nodes large, polygonal, flat, but well differentiated; the spores when fresh dull red in mass, paling with age; by transmitted light colorless, 6 μ, smooth.

A very singular species, easily recognizable by its long, slender stipes, terminating in exceedingly small spherical sporangia. The colors are obscure, but the striations on the calyculus are violet-tinted, and the reds perhaps predominate elsewhere. "In its scattered and solitary growth, its tall, slender stipes, and relaxed habit it resembles *C. microcarpa,* in its network it approaches *C. tenella,* and its spores have the color of the paler form of *C. purpurea.*" So Dr. Rex, *l. c.* Western forms of the first-named species have much shorter stipes; the network in the specimens before us is unlike that of *C. tenella,* but resembles that of *C. purpurea.*

Rare, on very rotten wood, in the forest. New York, Ohio, South Carolina, Ontario.

16. CRIBRARIA CUPREA *Morgan.*

PLATE XVII., Fig. 7.

1893. *Cribraria cuprea* Morg., *Jour. Cin. Soc.*, p. 16.

Sporangium very small, .33 mm., oval or somewhat obvoid, copper-colored, stipitate, nodding; stipe concolorous or darker below, subulate, curved at the apex, 2–4 times the sporangium; calyculus about one-half the sporangium, finely ribbed and granulose within, the margin nearly even; the net rather rudimentary, the meshes large, triangular or quadrilateral, the nodules also large, flat, concolorous, the threads slender, transparent, with free ends few; spores in mass copper-colored, by transmitted light colorless, smooth, 6–7 μ.

Recognizable by its small size and peculiar color, that of bright copper, although this fades somewhat with age, and the metallic tints are then lacking. Related to the preceding and in specimens having globular sporangia closely resembling it; but the ground color in *C. languescens* is always darker, and the stipe proportionally much longer. In habit the sporangia are widely scattered, much more than is common in the species of this genus. Miss Lister, *2nd ed.* regards this as a var. of No. 15.

Comparatively rare. Before us is one very small colony of sporangia from Iowa, one from Ohio, and a large number from Missouri. If one may judge from the material at hand, the favorite habitat is very rotten basswood, *Tilia americana.*

2. Dictydium (*Schrad.*) *Rost.*

Sporangia distinct, gregarious, globose or depressed-globose, stipitate, cernuous; the peridium very delicate, evanescent, thickened on the inside by numerous meridional costæ which are joined at frequent intervals by fine transverse threads more or less parallel to each other, forming a persistent network of rectangular meshes.

The ribs or costæ of the spore-case radiate from the top of the stipe and unite again at the top of the sporangium in a feeble, irregular net. Schrader, *Nov. Gen. Pl.,* p. 11, 1797, applied the name *Dictydium* to all *Cribraria*-like species in which the calyculus was wanting. Fries follows this, *Syst, Myc.,* III., p. 164. Rostafinski, *Versuch,* p. 5, *Mon.,* p. 229, first correctly limits the genus and separates it from *Cribraria.* 1873–75.

A single species is widely distributed throughout the world,—

1. Dictydium cancellatum (*Batsch*) *Macbr.*

Plate I., Figs. 6, 6 *a* and Plate XIX., Figs. 1, 1 *a*, 1 *b*, 1 *c*, 2, 3.

1789. *Mucor cancellatus* Batsch, *Elench. Fung.,* II., p. 131.
1797. *Dictydium umbilicatum* Schrad., *Nov. Gen. Pl.,* p. 11.
1801. *Cribraria cernua* Pers., *Syn.,* p. 189.
1816. *Dictydium cernuum* Nees, *Syst. d. Pilz.,* p. 117.
1875. *Dictydium cernuum* (Pers.) Rost., *Mon.,* p. 229.
1893. *Dictydium longipes* Morg., *Cin. Soc. Jour.,* p. 17, in part.

Sporangia gregarious, depressed globose, nodding, the apex at

length umbilicate, stipitate, in color brown, or brownish purple; the stipe varying much in length from two to ten times the diameter of the sporangium, attaining 5–6 mm., generally erect, more or less twisted and pallid at the apex, below dark brown, with hypothallus small or none; calyculus often wanting, when present a mere film connecting the ribs of the net; the net made up chiefly of meridional ribs connected at intervals by transverse parallel threads, above an open *Cribraria*-like network closing the apex and more or less rudimentary; the spores varying in color through all shades of brown and purple when seen in mass, by transmitted light reddish, 5–7 μ, smooth or nearly so.

This species in the United States is one of the most variable in the whole group. The extremes of such variation might easily constitute types for several distinct species were it not that in all directions the varieties shade into each other so completely as to defy definition. We have before us specimens purple throughout and short-stemmed; purple with stem long, pale and twisted at apex; brown, with the same variations; short-stemmed, with the apex of the stem pallid, and long-stemmed, with and without the same peculiarity. Morgan (*Cin. Soc. Nat. Hist. Jour.,* 1893) would set off the purple, long-stemmed forms as *D. longipes,* "stipe three to five times the sporangium," but here are forms in which the stem is ten times the diameter of the sporangium, which yet possess in all other particulars the characters of the short-stemmed forms. European forms also vary. Massee figures one type; Lister, one or two others; Rostafinski's figure indicates a taller form; Fries says, "Stipes elongatus, peridio quinquies et ultra longior." It seems reasonable to suppose that the variation is largely due to atmospheric conditions at the time of fruiting. The purple forms may be cases of arrested development, since the plasmodium appears to be in all cases purple, or at least they seem to represent those plasmodia which have failed of normal ripening. We may recognize two or three general types, distinguished primarily by color:—

a. *D. cancellatum cancellatum.*—Sporangia clear brown or with only a purplish tinge, the stipe tapering upward, and in extreme cases perfectly white at the twisted apex. The stipe in length ranges from three to ten times the diameter of the sporangium. The

reticulations of the net are generally small and the ribs numerous. This is the most highly differentiated, finished type of the species.

b. *D. cancellatum purpureum.*—Sporangium dark, the purple tints predominating, the stipe tapering upward, more or less twisted at the paler, sometimes almost colorless, apex. The stipe ranges a little shorter than in the preceding variety, three to seven times the sporangium. The reticulations of the net are often coarse, the ribs being fewer; the whole structure weak and showing signs of imperfect development.

The figures, 1, 1 *a*, 1 *b*, 1 *c*, *l. c.*, illustrate the ideal accomplishment in form (a). The color is a clear definite brown with no suggestion of purple anywhere. The stipes are three or four times the diameter of the sporangium, brown below, white above, and twisted to allow the sporangium to hang inverted. This is complete in every part; a definite bell-shaped calyx, widening into the cancellate receptacle, the margin constricted, and closed at last by the apical net, *cribrum,* sign of the order.

In form (b), the structure is similar but by no means so symmetrical and complete. The calyx often fails, or is present by obscure indications only. The cancellation is coarser, the number of ribs fewer, the whole sporangium more or less globose; ferruginous or purple, the prevailing tint. Figs. on Pl. I. are from the ferruginous type.

Figure 3 represents a beautiful thing; cup-less, ellipsoidal, delicate, of average size and in every way well-proportioned, clear rosy brown in color.

This may stand for a third variety; (c) *D. cancellatum prolatum.*

Common everywhere. The fruit appears in June on decaying logs and stumps of various species of deciduous trees, conifers, etc., the finest, and greatest variety, are from southern Missouri.

Order IV

LYCOGALALES

Fructification æthalioid; peridium membranaceous, tough, simple, without vesiculose with protoplasmic masses, within gelatinous; the

capillitium of cortical origin, consisting of irregular lobate or branching tubules, varying much in width, and marked by numerous corrugations, irregular warts or bands; spores minute, ashen or pallid.

This order includes but a single genus,—

Lycogala *Micheli.*

1729. *Lycogala* Micheli, *Nov. Plant. Gen.,* pp. 216, 217.
1753. *Lycoperdon* Linn. *Syst. Nat.,* in part.
1794. *Lycogala* Persoon, Römer, *N. Bot. Mag.,* p. 87.

Micheli's description and figures, *Nov. Plant. Gen.,* pp. 216, 217, Tab. 95, leave no doubt but that this illustrious man had species of *Lycogala* before him when he described the genus. His figure 1. no doubt portrays the second species in our present list. More recent writers, from Persoon down, have used Micheli's designation, but differed in regard to the limits to which the name should be applied. It is here used substantially as in 1729. Fries and, after him, Rostafinski make a mistake in quoting Retzius as writing *Lycogala* (1769). Retzius wrote *Lycoperdon sessile; Kongl. Vetenskaps Acad. Handling. för Ar* 1769, p. 254.

Key to the Species of Lycogala

A. Æthalia irregularly globose.
  a. Cortex minutely roughened or warted; about 12 mm. in diameter . . . . . 1. *L. epidendrum*
  b. Cortex smooth, size large . . . . . 2. *L. flavo-fuscum*
  c. Cortex rough; diameter 6 mm. or less . . 3. *L. exiguum*
B. Æthalia conical . . . . . 4. *L. conicum*

1. Lycogala epidendrum (*Buxb.*) *Fries.*

1721. *Lycoperdon epidendron,* etc., Buxb., *En. Pl. Hal.,* p. 203.
1753. *Lycoperdon epidendrum* Linn., *Sp. Pl.,* p. 1184.
1829. *Lycogala epidendrum* (Buxb.) Fries, Syst. Myc. III., p. 80.

Æthalia solitary or clustered, depressed spherical, or, when crowded, irregular, olivaceous or blackish, minutely warted, 3–10 mm. in diameter, dehiscing irregularly, but more often near the apex; peridium thin, but tough and persistent, made up of numerous agglutinated tubules enclosing in their meshes peculiar cell-like vesicles; capillitium parietal, consisting of long, branching, and anastomosing

flattened tubules extended inwardly among the spores, everywhere marked by transverse wrinkles, ridges, and warts, the free ends of the ultimate branchlets rounded, concolorous with the spores; spore-mass, when fresh, rosy, or ashen with a rosaceous or purplish tinge, becoming with age sordid or ochraceous, spores by transmitted light colorless, minutely roughened or reticulate, 5–6 μ.

This is not only a cosmopolitan species, but is no doubt the most common slime-mould in the world. Found everywhere on decaying wood of all sorts, more particularly on that of deciduous trees. It has likewise been long the subject of observation. It is doubtless the "*Fungus coccineus*" of Ray, 1690, and the type of Micheli's genus as here, 1729. The different colors assumed, from the rich scarlet of the emerging plasmodium to the glistening bronze of the newly formed æthalium, have suggested various descriptive names,— as *L. miniata* Pers., *L. chalybeum* of Batsch, and *L. plumbea* Schum. The peridium is by authors described as double. This is for description only. In structure the outer and inner peridium completely blend. The outer is predominately vesiculose, the inner more gelatinous. For discussion of the microscopic structure see under the next species.

Common. New England, west to Nebraska, South Dakota, Colorado, Washington, Oregon, California; Alberta to Nicaragua.

Lycogala terrestre Fr., *Syst. Myc.*, III., 83, appears to be a variety of the present species. In spores and capillitial thread the forms are indistinguishable; the difference is a matter of size, and to some extent, of the color of the wall. The specimens are a little larger, depressed and angular. The peridium is paler, smoother, though sometimes almost black, thin, ruptured irregularly. But the form and color of the peridium in the sporocarps of the older species vary much in response to external conditions; on a substratum affording scant nutrition the forms of fructification are minute; and in all cases, if maturity be hastened, the peridium responds in darker colors. Under more favorable conditions the wall is smoother and brighter.

2. Lycogala flavo-fuscum (*Ehr.*) *Rost.*

1818. *Diphtherium flavo-fuscum* Ehr., *Syl. Myc. Berol.*, p. 27.
1829. *Reticularia flavo-fusca* (Ehr.) Fries, *Syst. Myc.*, III., p. 88.
1873. *Lycogala flavo-fuscum* (Ehr.) Rost., *Versuch*, p. 3.

Æthalia solitary or sometimes two or three together, large 2–4 cm. in diameter, spherical or spheroidal, purplish-gray or brown, smooth, shining; the peridium thick, simple but in microscopic section showing two or three successive layers; capillitium of abundantly branching, irregular, transparent tubules, marked by numberless warts and transverse rings or wrinkles, spores in mass yellowish gray, by transmitted light, colorless, smooth or only faintly reticulate or roughened, 5–6 μ.

This, one of the largest and most striking of the slime-moulds, is by students generally mistaken for a puff-ball. It occurs on stumps and rotten logs of various sorts in the Mississippi valley, more often affecting stumps of *Acer saccharinum* L. The fructification, when solitary, about the size of a walnut, though sometimes larger; when clustered, the individuals are smaller. The form depends largely upon the place in which the fruit is formed. The plasmodic mass is so large that its form is determined by gravity. Thus on the lower surface of a log raised a little distance from the earth the æthalium is often pyriform. This fact did not escape Micheli. See *Nov. Plant. Gen.,* Tab. 95. The plasmodium is pale pink, soon becomes buff when exposed in fruiting, finally pallid or somewhat livid, and is outwardly changed into the stout, tough peridium. This consists of an intricate network of irregular gelatinous tubules enclosing within the meshes protoplasmic masses of pretty uniform size, 60–100 μ. Outwardly the protoplasmic vesicles predominate; inwardly the gelatinous tubules, which are, in some instances at least, continued toward the centre of fructification to form the capillitium. The protoplasmic masses referred to respond to ordinary stains, are often broken into numberless small cells corresponding in size and appearance to ordinary spores.

Not common. New England, Ohio, Iowa. Perhaps more abundant in the Mississippi valley; Canada.

3. Lycogala exiguum *Morg.*

1893. ***Lycogala exiguum*** Morg., *Jour. Cin. Soc.,* p. 8.

Æthalia small, 2–5 mm. in diameter, gregarious, globose, dark brown or black, sessile, minutely scaly, irregularly dehiscent; the

peridium thin, the vesicles comparatively few, in irregular patches which are more or less confluent; capillitium as in preceding species, the tubules slender and branching; spore-mass pale, ochraceous, spores by transmitted light colorless, almost smooth, 5–6 μ.

Found in the same situations as No. 1, and at the same season. Recognizable by its *gregarious* habit, not crowded nor superimposed, small size, and dusky color. The little spheres occur a dozen or more in a place, dark lead-colored, shading to black, opening rather regularly at the top. It looks like a depauperate *L. epidendrum,* but seems to be constantly collected.

Our specimens are from Ohio, Iowa, Missouri, Canada.

4. Lycogala conicum *Pers.*

1801. *Lycogala conica* Pers., *Syn. Fung.,* p. 159.
1875. *Dermodium conicum* (Pers.) Rost., *Mon.,* p. 284.

Æthalia scattered, sometimes two or three together, small 2–4, mm. high, conical, sessile, pallid, grayish brown, marked by obscure black reticulations, opening regularly at the somewhat acuminate tip; peridium thin in structure, as in *L. epidendrum,* but more delicate; capillitium made up of abundant, slender, uniform threads almost smooth, simple, the free ends obtuse, taking origin in the cortex much as in the preceding species; spores in mass ochraceous, by transmitted light colorless, minutely warted or faintly reticulate, about 5 μ.

A very distinct and rare little species. Well described by Persoon, who also appears to have observed the plasmodium "*primo rubra.*" The color of the mature form varies with age; at first somewhat purplish. Dr. Rex collected it in Pennsylvania; Mr. Morgan has it from Ohio; our specimens are from southeastern Missouri.

Order V

TRICHIALES

Fructification sporangial, rarely plasmodiocarpous, the sporangia stalked or sessile, gregarious or closely crowded, limeless throughout; the capillitium of definite threads, free or attached to the sporangial wall, isolated or combined into a net; spores generally some shade of yellow, never purple or black.

The distinguishing feature in this order is found in the peculiar sculpture of the capillitial threads. This is suggested by the tubules of *Lycogala,* though probably the resemblance is superficial only. The individual threads, as in *Trichia,* are called elaters, from their probable efficiency in spore-dispersal.

As here limited, the order is coextensive with the *Calonemeae* of Rostafinski, except that that includes in addition the genera *Prototrichia* and *Dianema.* The course of differentiation may be assumed to start with *Dianema,* through the *Perichaenaceae* to the *Arcyriaceae* and again from the same starting-point through *Prototrichia* to the *Trichiacae.*

Key to the Families of the Trichiales

A. Capillitial threads transverse to the sporangial cavity, attached usually at each end, plain or only slightly roughened . . *Dianemaceae*

B. Capillitium plain, papillose, or spinulose, often scanty, not netted, the threads sometimes attached by one end to the sporangium wall, *Perichaenaceae*

C. Capillitium a distinct net, usually attached below to the sporangial wall; sculpture various, not continuous spiral bands *Arcyriaceae*

D. Capillitial threads transverse, fascicled, attached at both ends, but sculptured by well defined spiral bands . . *Prototrichiaceae*

E. Capillitial threads typically free, sometimes more or less branched, forming a loose net attached below, characterized by definite spiral bands, or sometimes by scattered rings . . *Trichiaceae*

A. DIANEMACEÆ

Key to the Genera of the Dianemaceæ

A. Capillitial threads attached at one end, or free . 1. MARGARITA

B. Capillitial threads attached at each end . . . 2. DIANEMA

1. Margarita *List.*

1894. *Margarita* Lister, *Mycet.,* p. 203.

Sporangia sessile, the capillitium simple, hair-like, coiled.

1. MARGARITA METALLICA (*Berk. & Br.*) *List.*

PLATE XVII., Figs. — —

1838. *Physarum metallicum* Berk. & Br., *Mag. Zool. & Bot.,* I., p. 49.

Sporangia scattered or clustered, globose, or somewhat plasmodiocarpous, .5–1 mm., sessile, coppery iridescent, the peridium thin, open-

ing above irregularly; capillitium of long flexuous, coiling, simple or little dividing threads, nearly smooth, with infrequent attachments to the peridial wall; spores in mass yellowish, transparent under the lens, delicately verruculose, 10–12 μ.

One of the handsomer species of the present group. So far a Pacific coast form. California, Oregon, Washington; reported from Chile.

Dianema *Rex*

1891. *Dianema harveyi* Rex, *Proc. Phil. Acad.*, p. 397.

Sporangia simple or plasmodiocarpous; capillitium composed of threads without characteristic thickenings running entirely across the sporangium attached both to the base and to the opposite wall, not joined to form a network.

Key to Species of Dianema

A. Sporangia distinct, iridescent . . . . . 1. *D. harveyi*
B. Fructification more or less plasmodiocarpous, dull brown . . . . . 2. *D. corticatum*
C. Sporangia, some of them stipitate . . . 3. *D. andersoni*

1. Dianema harveyi *Rex.*

Plate XVI., Figs. 5 and 5 *b*.

1891. *Dianema harveyi* Rex, *Proc. Phil. Acad.*, p. 397.

Sporangia gregarious, generally rounded or cushion-shaped, depressed, sessile, iridescent bronze, 1 mm. in diameter; peridium thin, translucent, opening irregularly; capillitium of simple threads, not netted, but often forked two or three times, taut, running from base to top; spores yellow, by transmitted light pale yellowish, minutely roughened, 8–10 μ.

This interesting species was collected in Orono, Maine, in 1889, by Professor F. L. Harvey, and so far as can be learned has not been taken since. Mr. Lister records two species from England which he refers to this genus. As to its systematic place, Dr. Rex says, *l. c.* "It stands as a single representative of a new and separate family adjoining the *Perichaenacae* in the order *Calonemeae* of Rostafinski."

Rare. Maine.

2. DIANEMA CORTICATUM *List.*

PLATE XVI., Figs. 5 *a*, 5 *c*.

1894. *Dianema corticatum* List., *Mycetozoa*, p. 205.

"Plasmodium pink"; sporangia sometimes flat-hemispheric, more often ill-defined, united in irregular, depressed, netted plasmodiocarps, generally dull brown; peridium opaque, didermatous, capillitium of simple or rarely branching filaments, variously beaded or marked with spiral bands, lightly attached at either end, occasionally twisted together; spore-mass dull brown, the spores in clusters of four or more, colorless by transmitted light, more or less verruculose, ellipsoidal, about 8–10 μ.

Our specimens are from the mountains of Alberta.

A curious, flat plasmodiocarp, an inch or more in length. It suggests *Hemitrichia serpula* prematurely dry.

3. DIANEMA ANDERSONI, *Morg.*

Dianema andersoni, Morg. MS., *non. pub.*

Sporangium globose, sessile or substipitate, seated on a thin brownish hypothallus; the wall a thin smooth pinkish membrane, when dry rugulose and iridescent, the inner surface somewhat thickened below and brownish at the base. Capillitium arising out of the thickened base, the threads hyaline or pinkish, ascending, flexuous, simple, or branched a time or two, the extremities attached on all sides to the wall of the sporangium. Spores globose, very minutely warted, pale, pinkish, 10–11 μ, in diameter, free.

Growing on old wood and bark of *Alnus;* British Columbia, *W. B. Anderson.*

Sporangium spherical, 6–8 mm. in diameter, sessile or on a very short stipe. This species differs from *D. harveyi* Rex in the *uniform pinkish* color of the wall and of the *spores;* the dividing threads are furnished remotely with minute roundish tubercles as in *Didymium;* the spores are somewhat larger than in *D. harveyi.*

B. PERICHÆNACEÆ

Key to the Genera of the Perichænaceæ

A. Sporangia more or less plasmodiocarpous in type, terete; dehiscence irregular . . . . . 1. OPHIOTHECA

B. Sporangia more or less polygonal in outline, or round, depressed; dehiscence circumscissile . . . . . 2. PERICHÆNA

1. Ophiotheca *Currey.*

1869. *Ophiotheca pallida* Berk. & C., *Jour. Linn. Soc.,* X., p. 350.

Fructification generally plasmodiocarpous, terete, bent or flexuous, often annular or cornuate, rarely globose, opening irregularly, peridium thin, not polished, covered more or less strongly with a distinct layer of scales or granules; capillitium of slender, loosely branching filaments, the surface rough to strongly spinulose; spores yellow.

As a generic name *Ophiotheca* plainly has priority. *Cornuvia* as understood by Rostafinski has no representative so far in our region.

Key to the Species of Ophiotheca

A. Plasmodiocarp usually upon herbaceous stems, slender, 1. *O. vermicularis*

B. Plasmodiocarp on rotting bark, logs, etc,
a. Pale brownish or yellowish . . . . 2. *O. chrysosperma*
b. Chestnut brown or blackish . . . . . 3. *O. wrightii*

1. OPHIOTHECA VERMICULARIS (*Schw.*) *Macbr.*

1834. *Physarum vermicularis* Schw., *N. A. F.,* No. 2296.
1869. *Ophiotheca pallida* Berk. & C., *Jour. Lin. Soc.,* X., p. 350.
1873. *Ophiotheca umbrina* Berk. & C. Grev., II., p. 88.
1876. *Perichaena pallida* (Schw.) Rost., *Mon. App.,* p. 34.

Plasmodiocarp very slender, terete, elongate, flexuous or reticulate, annular, etc., of dull gray or neutral tint; the peridium thin, translucent, but with a delicate granular outer coating; capillitium of slender threads, frequently branched, warted and usually minutely spinulose; spore-mass ochraceous yellow; spores by transmitted light pale yellow, minutely roughened, 10 μ.

Perhaps common, but seldom collected, probably overlooked on account of protective coloration; the color is about that of the habitat, the weathered surface of dead herbaceous stems and roots. On dead corn stalks not infrequent. Differs from other species of the genus in having smoother capillitium, for which reason Rostafinski calls the present species *Perichaena vermicularis. O. pallida* Berk. & C. seems to us to be the same thing, *N. A. F.,* 726.

New England, New Jersey, South Carolina, Ontario, Ohio, Iowa.

2. Ophiotheca chrysoperma *Currey.*

1854. *Ophiotheca chrysosperma* Currey, *Quart. Mic. Jour.*, II., p. 240.
1875. *Cornuvia circumscissa* (Wallr.) Rost., *Mon.*, p. 290.
1911. *Perichaena chrysosperma* Lister, *Mycetozoa, 2nd ed.*, in part, p. 248.

Plasmodiocarp elongate, bent and curved in various ways, spherical, more rarely annular or even reticulate, yellowish or ochraceous brown, opening irregularly; peridium thin, with yellowish outer layer; capillitium rather abundant, of threads slender, sparingly branched and minutely but distinctly spinulose; spore-mass yellow, spores by transmitted light pale, almost smooth, about 8 μ.

Occurs on the inner bark of deciduous trees, especially of oak. Not common.

This is possibly *Cornuvia circumscissa* (*Wallr.*) of Rostafinski's monograph; but it is doubtful to what Wallroth referred. Rostafinski's other citations are equally uncertain. Currey's figures and description alone merit recognition.

Ohio, Iowa, Tennessee; Canada.

3. Ophiotheca wrightii *Berk.*

Plate II., Figs. 7, 7 *a*, 7 *b*.

1868. *Ophiotheca wrightii* Berk. & C., *Jour. Linn. Soc.*, X., p. 349.
1876. *Cornuvia wrightii* (Berk. & C.) Rost., *Mon. App.*, p. 36.
1892. *Cornuvia wrightii* (Berk. & C.) Macbr., *Bull. Lab. Nat. Hist. Ia.*, II., p. 122.
1911. *Perichaena chrysosperma* Lister, *Mycetozoa, 2nd ed.*, p. 248.

Plasmodiocarp bent or short-flexuous, often arcuate or completely annular, dark chestnut brown or black, opening irregularly; peridium thin, brittle, translucent, covered without by a rather dense layer of brownish or black brown scales; capillitium of long, sparingly branched threads furnished with projecting spinules remarkable for their length, about twice the diameter of the thread; spores yellow, minutely but distinctly warted, about 12 μ.

This is the common species everywhere on the inner side of the bark of fallen trees, *Ulmus*, etc. It is readily distinguished at sight by the peculiar annular, looped, and U-shaped plasmodiocarps, with their dark umbrine or blackened surface. From the preceding it

is especially distinguished by the spinulose capillitium and larger spores.

Not rare. New England, New York, Pennsylvania, Ohio.

2. Perichæna *Fries*

1817. *Perichaena* Fries, *Symb. Gast.*, p. 11.

Sporangia flattened, sometimes small and roundish, more often larger, polygonal by mutual interference, or irregular, the peridium thickened outwardly by a dense reddish or brownish layer of scales; dehiscing by circumscission or by a lid; capillitium often scant, of slender, warted, yellowish threads, attached betimes to the upper wall; spores yellow, oval or spherical.

Key to the Species of Perichæna

A. Sporangia plainly flattened.
- *a.* Very flat, sporangia 1mm. or more in width . 1. *P. depressa*
- *b.* Depressed; sporangia smaller . . . . 2. *P. quadrata*

B. Sporangia more or less spherical
- *a.* Chestnut brown . . . . . 3. *P. corticalis*
- *b.* Gray or canescent . . . . . 4. *P. marginata*

1. Perichaena depressa *Libert.*

Plate XVII., Fig. 10.

1837. *Perichaena depressa* Lib., *Fl. Crypt. Ard.*, IV., No., 378.

Sporangia sessile, applanate, crowded, polygonal by mutual contact, fuscous or chestnut brown, shining, opening by a definite lid; spore-mass and capillitium yellow, the capillitium well developed, of slender yellow threads of various widths, almost smooth; spores minutely warted, 10–12 μ.

Easily recognized by the peculiar, polygonal, depressed-flattened sporangia and consequent shallow spore-cases in which lie the yellow spores and scanty capillitium. Rostafinski refers here *P. vaporaria* Schw., No. 2311, but the meagre description seems rather to apply to the next species. The original material is no longer accessible.

In the crevices and on the inside of bark of fallen logs of various sorts, walnut, maple, etc.

Not commonly collected. Specimens are before us from New

England, Illinois, Iowa, Missouri, Florida, Mexico, Nicaragua. Probably over the whole wooded region of the continent.

2. Perichaena quadrata *Macbr.*

1893. *Perichaena irregularis* Berk. & C., Morgan, *Jour. Cin. Soc.*, p. 20.

Sporangia very small, less than ½ mm., crowded, polygonal or quadrangular, depressed, but not flattened, smooth, bright rufous or brown; the peridium rather thick, yellow within, the dehiscence circumscissile; capillitium scanty, of slender, sparingly branched filaments, the surface minutely roughened, warted or spinulose; spore-mass yellow; by transmitted light pale yellow, 9–11 μ.

Differs from the preceding by the much smaller size of the sporangia, different color and habit. The sporangia, while depressed, still maintain considerable rotundity; they are occasionally quite spherical, and then of very uneven size, hardly in contact. In some cases the plasmodium before maturing seems to assume the form of a plasmodiocarp, which, by transverse fission at intervals, forms the curious four-sided conceptacles. At other times the plasmodium assumes the shape of a flat cushion or plate, which then subdivides into minute polygonal segments. This form has been known some years to collectors, and, if named at all, has been called *P. irregularis*. Lister, *l. c.*, assures us that Berkeley's type "is typical *P. depressa*."

Not common. Pennsylvania, Ohio, Illinois, Missouri.

3. Perichaena corticalis (*Batsch*) *Rost.*

Plate II., Figs. 1, 1 *a*, 1 *b*.

1783. *Lycoperdon corticale* Batsch, *Elench. Fung.*, p. 155.
1875. *Perichaena corticalis* (Batsch) Rost., *Mon.*, p. 293.
1817. *Perichaena populina* Fries, *Symb. Gast.*, p. 12.

Sporangia sessile, gregarious, flattened, hemispherical; peridia simple, opening by a lid; dehiscence circumscissile, the upper part chestnut brown, the lower almost black; capillitium feebly developed, smooth, attached to the lid and usually coming away with it, bringing the brilliantly yellow spore-mass, and leaving a delicate, shining cupule adherent to the substratum; spores yellow, nearly smooth, 10–12 μ. On and under the bark of dead elms of various species.

A very handsome little species occuring rarely with us, or perhaps overlooked by virtue of its protective coloration. Found sometimes on the inner side of the bark where the latter has separated, but not yet wholly parted company with the wood. In such situations the tiny sporangia are so nearly quite the color of the moist substratum as to escape all but the closest scrutiny. The dehiscence is very remarkable, characteristic, beautiful. Black, brown, chestnut, and gold are harmoniously blended, in the opening coffers. Prior to maturity the future line of fission is plainly indicated by the difference in color.

This is clearly the species found by Batsch "ligni demortui putridi in interiore corticis pagina." Bulliard has also described and figured the species, *Sphaerocarpus sessilis* t. 417, Fig. V.

The capillitium is nearly smooth; the spores are only slightly roughened by minute warts.

Apparently not common. Iowa, Missouri; Black Hills, South Dakota; Canada;— *Miss Currie.*

4. PERICHAENA MARGINATA *Schweinitz.*

1831. *Perichaena marginata* Schw., *N. A. F.,* No. 2319, p. 258.

Sporangia depressed, globose, polygonal as they become approximate or crowded, hoary canescent, sessile; peridium rather thick, persistent, circumscissile in dehiscence, covered without by minute whitish calcareous (?) scales, within punctate by the imprint of the spores; hypothallus distinct, white; capillitium scant or none! Spores in mass dull yellow, by transmitted light pale, nearly smooth, 14–15 μ.

Lister, following Rostafinski, includes this form with the preceding. The differences between the two forms are, it seems to us, sufficient to make convenient their separation as by Schweinitz. Apart from the peculiar incrustation in the present species, the larger spores, and especially the peculiar white hypothallus, are distinctive. The method of dehiscence is also different. In *P. corticalis* the line of cleavage before spore dispersal is indicated by a definite band surrounding the sporangium. Nothing similar appears in the gray specimens of the present form, although the dehiscence is quite as certainly circumscissile. The habitat in American specimens is the

outer surface of the bark, which causes the species generally, by protective coloration, to be overlooked.

Not common. Pennsylvania, Ohio, Missouri.

C. ARCYRIACEÆ

Key to the Genera of the Arcyriaceæ

A. Peridium becoming fragmentary, but persisting; capillitium non-elastic 1. LACHNOBOLUS

B. Peridium evanescent above, persistent below; capillitium elastic, 2. ARCYRIA

C. Capillitium elastic, bearing hamate branches, 3. HETEROTRICHIA

1. Lachnobolus *Fries.*

1829. *Lachnobolus* Fries, *Syst. Myc.,* III., p. 177.

Sporangia distinct, sessile or nearly so, globose or cylindric, often distorted, scattered or densely crowded, the peridium extremely thin, ruptured irregularly, and persistent in fragments; capillitium attached at numerous points to the sporangial wall, forming a dense net, the threads warted or spinulose, non-elastic.

Species of this genus are easily distinguished from those of the next by the peculiar fragile peridium and the inelastic capillitium.

Key to the Species of Lachnobolus

A. Sporangia pale yellow, on fallen flowers and fruit-burs of *Castanea,* 1. *L. globosus*

B. Sporangia rosy or copper-colored, at length ochraceous, 2. *L. occidentalis*

1. LACHNOBOLUS GLOBOSUS (*Schw.*) *Rost.*

1822. *Arcyria globosa* Schw., *Syn. Fung. Carol.,* No. 400.
1875. *Lachnobolus globosus* (Schw.) *Rost., Mon.,* p. 283.
1894. *Arcyria albida* Pers. (in part) Lister, *Mycetozoa,* p. 186.

Sporangia on the spines of fallen chestnut burs, scattered, pale yellow or whitish, small, globose, the peridium early evanescent above, more persistent below, stipitate; stipe small, tapering upward, from a small hypothallus; capillitium a dense but not expanding network attached chiefly to the lower portion of the sporangial wall, minutely

warted or roughened, with few expansions or inflations; spores in mass pale yellow, under the lens colorless, almost smooth, 7–8 μ.

This singular little species is remarkable chiefly in the habitat it affects,—fallen chestnut burs. On these almost universal, but on nothing else, except on the fallen catkins of the same species. Regarded by Mr. Lister as *A. cinerea,* from which it differs constantly in form, in capillitium more open and with larger threads, 4–5 μ in diameter as well as in its unique habitat, and yellowish color.

Distribution coterminous with that of *Castanea dentata* Borkhausen,— eastern half of the United States.

2. Lachnobolus occidentalis *Macbr.*

Plate II., Figs. 2, 2 *a*, 2 *b*; 4 and 4 *a*.

1885. ***Lachnobolus incarnatus*** (Alb. & Schw.) Macbr., ***Bull. Lab. Nat. Hist. Iowa,*** II., p. 126.

Sporangia scattered or crowded upon a hypothallus more or less distinct, globose or ellipsoidal, short-stipitate, varying somewhat in color, at first rosy or flesh-colored, later brownish or ochraceous; the peridium exceedingly thin, pellucid, mealy, evanescent above, persisting as a shallow cup below; capillitium inelastic, rather closely netted of threads variable in thickness, marked by frequent thickenings or expansions, everywhere warted, attached to the peridial walls, spores in mass flesh-colored, under the lens colorless, smooth, globose, 7.5–9 μ.

This delicate and elegant little species appears to be not uncommon, but is probably generally passed over as an *Arcyria,* which it superficially resembles. When newly formed, the sporangia have a peculiar rosy or flesh-colored metallic tint, which is all their own. Within a short time this color passes, and most of the material comes from the field brownish or ochraceous in color. Typical sporangia are spherical on distinct short stipes; when crowded, the shape is of course less definite. The capillitium never expands as in *Arcyria,* but, exposed by the vanishing upper wall, remains a spherical mass resting upon the shallow cup-like base of the peridium.

This species has been in the United States generally distributed as *L. incarnatus* (Alb. & Schw.) Schroet. A careful study of all de-

scriptions of European forms and comparison of many specimens leads us to believe that we have here to do with a type presenting constant peculiarities. We have in America nothing to correspond with the figures of Schweinitz, Berkeley, or Lister. In the American gatherings the sporangia are uniformly regular, globose, very generally short-stipitate, more or less closely gregarious, never superimposed, or heaped as shown in Berkeley's figure, for instance, *Ann. and Mag. Nat. Hist.,* IV., xvii., Pl. ix., Fig. 2. The plasmodium of our species is white; as it approaches maturity a rosy metallic tinge supervenes, quickly changing to dull yellow or alutaceous. The graphic description given by Fries of *Perichaena incarnata, Syst. Myc.,* III., p. 193, presents scarcely a character attributable to the form before us. *L. congesta* Berk. & Br., evidently the form figured and described by Lister, *Mycetozoa,* p. 194, Pl. lxx., B., resembles our species in color and capillitium, but is entirely different in habit.

Not uncommon. Maine, Iowa, Missouri, Nebraska.

2. Arcyria (*Hill*) *Pers.*

1751. *Arcyria* Sir John Hill, *Gen. Nat. Hist.,* II., p. 47.
1801. *Arcyria* Pers., *Syn. Fung.,* p. 182.

Sporangia ovoid or cylindric or even globose, stipitate; the peridium thin, evanescent to near the base, the lower part persisting as a calyculus; the stipe variable, packed with free cell-like vesicles, resembling spores, but larger; capillitium attached below, to the interior of the stipe or to the calyculus, in form an elastic network, the tubules adorned with warts, spinules, half-rings, etc., but without spiral bands or free extremities.

Micheli, of course, discovered the arcyrias, put them in two genera and several species, which we may only dimly recognize. Persoon first saw distinctly the outlines of the genus as now understood and adopted the name given by Hill in his curiously prolix description of certain species, probably partly of the genus *Arcyria,* partly *Stemonitis.*

Key to the Species of Arcyria

A. Mature capillitium loosely adhering to the calyculus.
a. Mature capillitium far-expanded, drooping.

i. Dusky.
* Long, 12 mm. or more . . . . . 1. *A. magna*
** Shorter, about 6 mm. . . . . 2. *A. oerstedtii*
ii. Yellow . . . . . 3. *A. nutans*
b. Mature capillitium short, not drooping, though sometimes procumbent.
i. Capillitium greenish yellow . . . . 4. *A. versicolor*
ii. Capillitium reddish, flesh-colored, at length sordid, etc.
* Capillitium marked by transverse half-rings, cogs, etc. 5. *A. incarnata*
** Capillitium marked by sharp-edged transverse plates and by numerous nodes . . . . 6. *A. nodulosa*
*** Capillitium marked by close reticulations, 7. *A. ferruginea*
B. Capillitium persistently attached to the calyculus.
a. Sporangia reddish brown, etc. . . . . 8. *A. denudata*
b. Sporangia gray or ashen
i Simple . . . . . 9. *A. cinerea*
ii. Clustered . . . . . 10. *A. digitata*
c. Sporangia yellow . . . . . 11. *A. pomiformis*
d. Sporangia rose-colored, .5-1.5 mm. . . . 12. *A. insignis*

1. Arcyria magna *Rex.*

1893. *Arcyria magna* Rex, *Proc. Phil. Acad.*, p. 364.

Sporangia densely aggregated, forming clusters of greater or less extent, sometimes reaching several centimetres in either direction, tawny gray or ashen, cylindric, tapering a little above, when expanded reaching a length of half a centimetre or more, stipitate; peridium evanescent except the small shallow cup-like base, the calyculus; stipe long (1 mm.), weak, pale brown or reddish, tubular, the channel filled with plasmodic masses; capillitium gray or drab-colored, very slightly attached to the bottom of the calyculus, far expanded, forming a loose-meshed net, the threads regular, cylindric, coarsely sculptured with rings, half-rings, cogs, spines, etc.; spores in mass dull gray, drab, under the lens colorless, papillate, with few papillæ, 7–8 μ.

This magnificent form resembles in habit and general appearance, save color, *A. nutans*. The capillitium is, however, very different both in the sculpture and in the more delicate markings of the threads. Dr. Rex, *l. c.*, has pointed out the lack of reticulation on the capillitium and calyculus. The color is also diagnostic. A roseate vari-

ety seems to occur with the present form. This is *A. magna rosea* Rex, and appears to agree with the type in all respects save color. The relationship here must be determined by future inquiry. The capillitial threads are remarkable for their graceful slenderness, regularity, and symmetry.

2. Arcyria oerstedtii *Rost.*

1875. *Arcyria oerstedtii* Rost., *Mon.*, p. 278, Fig. 196.

Sporangia cylindric, arcuate, 1.5 mm. high when unexpanded, closely clustered, dull crimson, stipitate; peridium evanescent except here and there a persistent patch, the calyculus shallow, plicate, papillose within; stipe short, weak, concolorous; hypothallus distinct, membranous, concolorous; capillitium a loose, far-expanding, elastic net, the meshes uneven, often small, the threads characterized by much irregularity and many bulbose thickenings, especially at the nodes, strongly spinulose throughout; spore-mass crimson or reddish brown, dull; spores by transmitted light colorless, nearly smooth, sub-globose, 9–10 μ.

This well-marked species is certainly rare within our limits. We have specimens from New England and from Pennsylvania. The Iowa material referred to this species, *Bull. Lab. Nat. Hist. Ia.*, II., p. 125, is *A. magna* Rex. Rostafinski's figure is excellent in the present case, and gives the idea of what we regard the typical marking of the capillitium in *A. oerstedtii.* Externally the species resembles somewhat *A. nodulosa,* and the network of the capillitium is also suggestive of that form; the spiny capillitium is unique.

Rare. Adirondacks, New York — *Dr. Rex.*

3. Arcyria nutans (*Bull.*) *Grev.*

Plate II., Figs. *6, 6 a, 6 b.*

1791. *Trichia nutans* Bulliard, *Champ.*, p. 122, t. 502, III.
1794. *Arcyria flava* Pers., *Römer N. Mag. Bot.*, I., p. 90.
1824. *Arcyria nutans* Grev., *Fl. Edin.*, p. 455.

Sporangia crowded, cylindric, about 2 mm. high when unexpanded, pale yellow or buff, short-stipitate or sessile by an acute base; peridium

wholly evanescent, except at the base, where persists the shallow, colorless, often inwardly spinulose, plicatulate calyculus; stipe very short or wanting; hypothallus thin but usually in evidence; capillitium expanding to great length, forming an extremely flexile, plumose, pendulose open network of pale ochraceous tint, the threads 3–4 μ in thickness, adorned with spinules, sharp edged transverse plates sometimes rings, the surface especially marked by an indistinct reticulation; spore-mass buff or ochraceous, spores by transmitted light colorless, smooth or nearly so, 7–8 μ.

This elegant species is not rare in undisturbed woods, especially on fallen willows. The expanded capillitia are very soft and plume-like, waving and nodding, very lightly attached below to the centre of the peridial cup. The capillitium threads are rough, with irregular spines and sharp-edged transverse plates, occasionally extending to form rings. Resembles the first species somewhat in habit, size, and the spinescent capillitium, but the resemblance is superficial only. The color is at once diagnostic, and the capillitium is after all entirely different. Not uncommon; Canada to Mexico; Maine to California; probably cosmopolitan.

Bulliard's figure determines the synonymy. Persoon called the form *A. flava,* because Bulliard had missed the genus.

4. Arcyria versicolor *Phillips.*

1877. *Arcyria versicolor* Phillips, *Grev.,* V., p. 115.
1877. *Arcyria vitellina* Phillips, *Grev.,* V., p. 115.

Sporangia gregarious or more or less crowded, pyriform or clavate, dingy, olivaceous yellow, becoming reddish, stipitate; peridium membranous, largely persistent below, where it gives rise to the deep, goblet-shaped calyculus; stipe strand-like, weak, sometimes wanting, concolorous with the peridium; hypothallus prominent or venulose; capillitium only slowly expanded, bright golden yellow or orange, the threads rather broad, about 4 μ in diameter, regular, even, elegantly branching, adorned with abundant short spines or warts, very small and evenly distributed, the whole net anchored in the bottom of the vasiform calyculus; spore-mass yellow, by transmitted light pale or nearly colorless, smooth, about 10 μ.

This beautiful species is easily known by its comparatively large size, peculiar, obovate shape, its brilliant color, and unusually persistent membranous calyculus. It is peculiar to the western part of North America, South Dakota west to the Pacific Ocean.

South Dakota, Colorado, California, Washington.

In the thin-covered mountains of Colorado, or hidden by the still drier thickets and woods of Southern Californa, the fruit of this species is small, somewhat as the clavate hemitrichia, pure, deep yellow, golden or vitelline as Phillips says; but at loftier altitudes in the ever cool forests on the high mountain flanks, beginning away up where the glacier first starts to crack and slide between the 'cleavers', and forests of stunted white-stemmed pine or wooly-fruited fir throw down their twigs and foliage undisturbed through centuries, —on down to where the plowing ice forgets its thrust, and melts to gentle floods amid spruce and hemlock-groves,—all the way the beautiful versicolor spreads and fruits, in August and September in all the richness of color which its name implies, which Phillips saw, tints of red, and yellow, and olive, and green, not brilliant, but in all the softer shades the artists love, weaving, in far-spread strands of tufted cylinders and cones upturned, fair as flowers, dusky garlands, by sunlight long forgot! Did not the old-time botanists liken these things once and again, to flowers!

5. Arcyria incarnata *Persoon.*

1786. *Clathrus adnatus* Batsch, *Elench. Fung.*, 141. (?)
1791. *Arcyria incarnata* Pers., Gmel., *Syst. Nat.*, II., 1467.

Sporangia closely crowded, cylindric, 1–1.5 mm. high, rosy or flesh-colored, stipitate or almost sessile; stipe generally short, sometimes barely a conical point beneath the calyculus; hypothallus none; peridium wholly evanescent, except the shallow, saucer-like, inwardly roughened calyculus; capillitium loose, broad, pale reddish, attached to the cup at the centre only by strands which enter the hollow stem, the threads adorned with transverse plates, cogs, ridges, etc., arranged in an open spiral; spore-mass rosy, spores by transmitted light colorless, nearly smooth, 7–8 μ.

This common species is well marked both by its color and by the

delicate attachment of the capillitium to the calyculus. This is so frail that the slightest breath ofttimes suffices to effect a separation, and the empty calyculi are not infrequently the only evidence of the fructification. This peculiarity did not escape the attention of Persoon, and is well shown in his figure (*Obs. Myc.* I., p. 58, pl. V. Figs. 4 and 5) referred to by Gmelin, *l. c.* Batsch simply named and described Micheli's figure (Tab. XCIV., Fig. 2), and accordingly his claim to priority is no better than Micheli's figure, which may possibly concern the present species, but is in no sense determinative. It is impossible to say what Retzius meant by his *Clathrus ramosus,* cited by Fries as a synonym here.

Common, especially in the Mississippi valley and south; more rare in the west; Black Hills, South Dakota; Toronto to New Mexico.

6. Arcyria nodulosa *Macbr.*

Plate III., Fig. 8.

Sporangia small, about 1 mm. high when unexpanded, crowded in clusters of varying size, dull red or brownish, stipitate; the peridium evanescent except the cup; stipe very short, concolorous, plicate as the cup, or both smooth and unmarked; capillitium centrally attached, slowly expanded, open-meshed, dense, the threads even, 5–6 μ wide, expanded in globose, spinulose, or papillate-reticulate nodules, especially at points of intersection, marked everywhere by close-set, transverse, sharp-edged ridges, which encircle the thread and show no trace of spiral arrangement; spore-mass brown or red brown; spores by transmitted light pale yellow or colorless, minutely but distinctly roughened, globose, 10–12 μ.

This variety is not distantly related to the preceding, as shown by the centrally attached capillitial mass, but differs in several definite particulars; the sporangia are much smaller of an entirely different color with longer stipes, larger, rougher spores; the capillitium is also peculiar, the threads unusually wide and densely corrugated transversely, expanding at frequent intervals into globose nodules which are sometimes double the width of the thread. In color suggests *A. affinis* Rost., but corresponds to no other particular.

7. Arcyria ferruginea *Sauter.*

Plate XII., Figs. 6, 6 *a*, 6 *b*.

1841. *Arcyria ferruginea* Saut., *Flora,* XXIV., p. 316.
1881. *Arcyria macrospora* Peck, *Rep. N. Y. Mus.* XXXIV., p. 43
1883. *Arcyria aurantiaca* Raunier, *Myx. Dan.,* p. (44).

Sporangia ovoid or short cylindric, crowded or gregarious, dull red or brownish, stipitate; stipe about equal to the sporangium, dark brown or black; hypothallus well developed, membranous, yellowish brown continuous; calyculus large, wide and shallow, smooth; capillitium centrally attached, when fresh, brick-red in color, fading on exposure, the threads of uneven size, those above 6–7 μ, below 3 μ, abundantly branching, marked by conspicuous reticulations formed by the intersection of numerous vertical plates or ridges; spore-mass reddish, spores by transmitted light pale ochraceous, distinctly warted, 10–12 μ.

This species is distinguishable at sight by the peculiar color and form of the sporangia. Mr. Durand in *Bot. Gaz.,* XIX., pp 89, 90, gives a careful study of the form. The same author declares the dehiscence circumscissile. We cannot distinguish *A. aurantiaca* Raun. from the present form.

Rare. Maine, New York; Monterey, California.

8. Arcyria denudata (*Linn.*) *Sheldon.*

Plate II., Figs. 5, 5 *a*.

1753. *Clathrus denudatus* Linn., *Syst. Nat.,* 1179.
1794. *Arcyria punicea* Pers., *Röm. N. Mag. Bot.,* I., p. 90.
1895. *Arcyria denudata* (Linn.) Sheld., *Minn. Bot. Studies,* No. 9, p. 470.

Sporangia crowded or gregarious, ovoid or short cylindrical, tapering upward, red-brown, stipitate; peridium evanescent except the plicate calyculus; stipe about equal to the expanded capillitium, concolorous, plicate or striate, ascending from a small hypothallus; capillitium attached to the whole inner surface of the calyculus and connate with it; hence not deciduous, bright red or carmine when fresh, turning brown or paler with age, the threads even, about 3 μ adorned with a series of rather distant cogs or half rings, which

form around the thread a lengthened spiral; spore-mass red or reddish brown, spores by transmitted light colorless, nearly smooth, 6–8 μ.

This species is easily distinguished from all other of similar tints by the attachment of the capillitium. In this respect it corresponds with the following species. In the adornment of the threads it is like *A. incarnata.* It is by far the commonest species of the genus, and probably enjoys a world-wide distribution. To be found at all seasons on the lower side of fallen sticks, *Populus, Tilia,* etc.

Micheli, Pl. XCIV., shows that he had the present species. The description given by Linné is worthless, but helped out by Micheli, and several other authors of the eighteenth century, who take the trouble to describe the species, but still give the Linnean binomial as a synonym; we may give Linné here the credit. As a matter of fact, Batsch under *Embolus crocatus* first presents an unmistakable description and figure.

Maine to the Black Hills and Colorado, and north and west; Alaska to Nicaragua.

9. Arcyria cinerea (*Bull.*) *Pers.*

Plate II., Figs. 3, 3 *a.*

1791. *Trichia cinerea* Bull., *Champ. de France,* p. 120, Tab. 477, Fig. iii
1801. *Arcyria cinerea* (Bull.) Pers., *Syn. Fung.,* p. 184.

Sporangia scattered or gregarious, ovoid or cylindrical, generally tapering upward, about 2–3 mm. high, ashen gray, sometimes with a yellowish tinge, stipitate; calyculus very small, thin; stipe about half the total height, rising from a small hypothallus, thin, gray or blackish, densely crowded with spore-like cells; capillitium dense, freely branching, ashen, or yellowish, little wider below, minutely spinulose; spore-mass concolorous, spores by transmitted light colorless, smooth, 6–7 μ.

A very common little species, easily recognized by its color and habit. The capillitium is more dense than in any other species and expands less. The stipe is about equal to the expanded capillitium, unusually long. The plasmodium occurs in rotten wood, especially species of *Tilia,* is gray and, judging from the number of sporangia found in one place, scanty.

Bulliard, *l. c.*, gives the first account of the species by which it can with any certainty be identified. By some authors *Clathrus recutitus* Linn. is cited as a synonym. We fail to distinguish *A. cookei* Mass. from the old type.

Widely distributed; Maine to Alaska, and south to Mexico and Nicaragua.

10. ARCYRIA DIGITATA (*Schw.*) *Rost.*

1831. *Stemonitis digitata* Schw., *N. A. F.*, p. 260, No. 2350.
1868. *Arcyria bicolor* Berk. & C., *Jour. Linn. Soc.*, X., p. 349.
1875. *Arcyria digitata* (Schw.) Rost., *Mon.*, p. 274.

Sporangia compound, that is gathered in tufts, number 3–12 or more on a single stipe, the clusters themselves scattered; individual sporangia elongate cylindric, about 3–4 mm. long, ashen gray or nearly white, stipitate; stipe as long or longer than the sporangium, stout, sometimes showing traces of consolidation of several, sometimes none, dark brown or black; capillitium looser and more expanded than in the last, the threads more strongly spinulose; spore-mass concolorous, spores under the lens colorless, smooth, globose, 7.5–8 μ.

Closely related to the preceding, but different in habit and on the whole larger and more robust throughout. The stipes in some cases are completely merged in one; in others traces of coalescence remain. The number of united sporangia varies. There are some clusters before us containing 16 and 18 in a single fascicle!

Not very common. On rotten wood of deciduous trees, especially south.

New England, Pennsylvania, Ohio; Black Hills, South Dakota, and south to Nicaragua.

Arcyria bicolor Berk. & C. seems to refer to the fact that the sporangia have sometimes an ochraceous tint. Berkeley's specimens are from Cuba. Our latest specimens are from Nicaragua; the form seems not to be reported from the old world.

11. ARCYRIA POMIFORMIS (*Leers*) *Rost.*

1775. *Mucor pomiformis* Leers, *Flor. Herb.*, p. 218.
1875. *Arcyria pomiformis* Rost., *Mon.*, p. 271.

Sporangia scattered, gregarious, globose, bright yellow, very minute,

.5 mm. high, .3 mm. in diameter, stipitate; stipe short, one-third the total height, pale brown or yellow; hypothallus none; capillitium loose, freely expanding, not deciduous, honey-yellow, the threads generally wide, 4–5 μ, toward the periphery more narrow, 2.5 μ warted, marked with blunt spinules, which not infrequently pass into distinct transverse, narrow plates or half-rings, free ends clavate and numerous; spore-mass yellow, spores by transmitted light smooth, granular, globose, 7–9 μ.

This species as represented by the material before us seems constant in size, color, and microscopic characters, in all which it differs from all species here listed. It resembles somewhat *Lachnobolus globosus* Schw., but differs in habit, habitat, color, the capillitium, its attachment and in the mode of dehiscence. In the present species the wall is evanescent almost *in toto;* in *L. globosus* is it remarkably persistent, and the capillitium is adherent.

Probably rare. Its smallness removes it from sight of all but the most exact collectors. Maine, New York, South Carolina, Alabama, Missouri, Iowa; Black Hills, South Dakota; Ontario;—*Miss Currie.*

While usually remotely gregarious a collection from southern California shows that on occasion the entire plasmodium may pass to fruit with narrowest limits, forming a stipitate, compact, globose mass of crowded, super-imposed sporangia as in *Oligonema nitens.* Set Plate XX., Fig. 12.

12. Arcyria insignis *Kalkbr. & Cke.*

1882. *Arcyria insignis* Kalkbr. & Cke., *Grev.,* X., p. 143.
1911. *Arcyria insignis* Kalkbr. & Cke., List., *Mycet., 2nd ed.,* p. 240.

Sporangia gregarious or clustered, pale or bright rose-colored, .5–1.5 mm. in height, stipitate, ovate or cylindric; stipe short, .2–.4 mm. red, with spore-like cells; capillitium a close net-work of delicate threads with a few bulbous free ends, with faint transverse bands or short spinules, or nearly smooth, colorless beneath the lens; spores colorless, nearly smooth, 6–8 μ.

Reported from Mass. by Miss Lister. Should follow No. 8: apparently a very delicate form of the common species, *A. denudata.*

3. Heterotrichia *Mass.*

1892. *Heterotrichia* Mass., *Mon.*, p. 139.

Sporangia distinct, stipitate; the peridium simple evanescent above as in *Arcyria;* capillitium centrally attached, freely branched, the threads within very slender, without broad, anastomosing to form a dense peripheral network, and everywhere extended to form short, free, often hamate tips. A single species,—

1. Heterotrichia gabriellae (*Rav.*) *Mass.*

Plate XIII., Figs. 1, 1 a.

1850. *Arcyria gabriellae* Rav. *in litt. ad Cooke.*
1892. *Heterotrichia gabriellae* Mass., *Mon.*, p. 140.
1911. *Arcyria ferruginea* Saut., var. *heterotrichia* List., *Mycet., 2nd ed.*, p. 234.

Sporangia crowded or gregarious, oblong cylindric, ovoid, at first red, becoming yellowish brown, stipitate; the peridium evanscent except the calyculus, which is small and thin, polished; stipe shorter than the expanded capillitium, pale reddish brown; capillitium centrally attached, showing threads of two sorts, those within freely branching, slender, 1–1½ μ, marked with half-rings or ridges, those on the periphery very different, yellow, broad, 5–6 μ, forming rather dense reticulations, with abundant free tips, acute and often curved, the whole surface here minutely and densely warted; spore-mass reddish yellow, spores by transmitted light colorless, globose, 7–8 μ.

The peculiar double capillitium seems to separate this form from the true arcyrias. Some difference in the diameter of the capillitial threads in different regions is not infrequent in the several species of *Arcyria,* but that difference is here emphasized and rendered yet more striking by the peculiar free tips. The present forms bear only the most superficial resemblance to *A. ferruginea* Saut., with which species it is in some quarters sought to unite it.

Very rare. Collected, as noted, nearly fifty years ago in South Carolina by Ravenel, it was more recently (1896) again collected in Maine by the late Professor Harvey.

D. PROTOTRICHIACEÆ

A single genus,—

Prototrichia *Rost.*

1876. *Prototrichia* Rost., *Mon. App.*, p. 38.

A single species,—

1. PROTOTRICHIA METALLICA (*Berk.*) *Mass.*

PLATE XVIII., Figs. 12, 12 *a*, 12 *b*.

1860. *Trichia metallica* Berk. Hook., *Fl. Tasm.*, 2, p. 168.
1866. *Trichia flagellifera* Berk. & Br., *Ann. Mag. Nat. Hist.*, 3, XVII., p. 56.
1876. *Prototrichia flagellifera* (Berk.) Rost. *Mon. App.*, p. 38.
1894. *Prototrichia flagellifera* Rost., List., *Mycet. 2nd ed.*, p. 206.
1899. *Prototrichia flagellifera* (Berk. & Br.) Rost., Macbr., *N. A. S.*, p. 199.
1892. *Prototrichia metallica* Mass., *Mon.*, p. 127.
1911. *Prototrichia metallica* Mass., List., *Mycet., 2nd ed.*, p. 260.

Sporangia sessile, scattered or sometimes crowded, brown, sometimes with a rosy tinge, about 1 mm. in diameter; peridium a thin, transparent, iridescent membrane, bearing in its inner surface the distal attachments of the capillitial threads; capillitium of numerous brown, spirally banded threads, which take origin in the base of the sporangium, become subdivided as they ascend, and are at length attached by their tips to the sporangium wall; spore-mass brown, spores by transmitted light pale, minutely roughened.

This curious form, with its spirally sculptured capillitial threads attached at both ends, stands intermediate between *Dianema* and *Hemitrichia* and *Trichia*. Berkeley called it a trichia, ignoring the attachment of the threads. Cooke notes this as sufficient to exclude the form from the genus. But it remained for Rostafinski to make the transfer by setting up for its reception the genus now adopted. He preferred the later (1866) specific name as more descriptive. Miss Lister reverts to the earlier name with the remark; "Little now remains of the type *Prototrichia metallica* Berk. from Tasmania; but the specimen is referred to *Prototrichia flagellifera* by Rostafinski who saw it in good condition."

Not uncommon in the abietine forests of the West. Alberta, Oregon, Washington, California, Nevada, Montana, Idaho, Colorado.

E. TRICHIACEÆ

Capillitium marked by spiral bands, sometimes scattered rings, etc., the threads entirely free, or at least loosely branched, and with free tips more or less numerous.

Key to the Genera of the Trichiaceæ

A. Capillitium threads long, generally united to form a loose net, centrally attached.
- *a.* Sculpture spiral . . . . . 1. *Hemitrichia*
- *b.* Sculpture reticulate . . . . . 2. *Calonema*

B. Capillitial threads shorter, entirely free, though sometimes branched.
- *a.* Threads, elaters, marked by spiral bands . . 3. *Trichia*
- *b.* Sculpture irregular or wanting . . . . 4. *Oligonema*

1. Hemitrichia *Rost.*

1829. *Hemiarcyria* Fries, *Syst. Myc.*, III., p. 183 in part.
1873. *Hemitrichia* Rost., *Versuch*, p. 14.

Capillitium a tangled net of more or less branching and anastomosing fibres centrally attached; the sculpture regular, of conspicuous spirally winding bands or ridges; habit and color various.

The species here associated are intermediate between *Arcyria* and *Trichia*, resembling the former in the capillitial net and the latter in thread-sculpture. Fries applied the name *Hemiarcyrieae* to a group of trichias so-called, citing *H. rubiformis* as the first. In his *Versuch* Rostafinski wrote *Hemitrichia* and afterward *Hemiarcyria* in the *Monograph*. Massee combines the genera *Arcyria* and *Hemiarcyria* under the former name.

Key to the Species of Hemitrichia

A. Plasmodiocarpous
- *a.* Plasmodiocarp net-like, yellow . . . 1. *H. serpula*
- *b.* Imperfectly plasmodiocarpous, brown . . 2. *H. karstenii*

B. Sporangia all distinct.
- *a.* Sessile; very short stalked
  - i. Peridium hyaline, iridescent . . . . 3. *H. ovata*
  - ii. Peridium opaque . . . . . 10. *H. montana*
- *b.* Stipitate, generally distinctly so; sometimes nearly sessile.
  - i. Yellow or ochraceous.
    - * Stalk hollow.
      - † Small, ½ mm., iridescent . . 6. *H. leiocarpa*
      - †† Larger, 1 mm., smooth but not iridescent

1. Free ends more or less abundant, 8. *H. clavata*
2. Free ends none . . . . 9. *H. stipitata*
* Stalk solid . . . . . 7. *H. intorta*
ii. Not yellow.
* Ruby red . . . . . 4. *H. vesparium*
** Copper-colored . . . . . 5. *H. stipata*

1. Hemitrichia serpula *(Scop.) Rost.*

Plate III., Figs. 4, 4 *a*, 4 *b*.

1772. *Mucor serpula* Scop., *Fl. Carn,* II., p. 493.
1794. *Trichia serpula* (Scop.) Pers., *Röm. N. Bot. Mag.,* I., p. 90
1875. *Hemiarcyria serpula* (Scop.) Rost., *Mon.,* p. 266.

Fructification plasmodiocarpous, often covering several square centimetres, terete, branching freely and usually everywhere reticulate, rusty, tawny, or bright yellow; the peridium thin, transparent, with irregular dehiscence; hypothallus none; capillitium variable, a tangle of long yellow threads, sparingly branched, free everywhere, except below, spinulose, the free tips spinose, acuminate, spiral ridges three or four, with traces of longitudinal striæ; spore-mass golden yellow, spores beneath the lens pale yellow, globose, delicately reticulate, about 10 μ.

Very common, recognized by its bright yellow color and conspicuous reticulate habit. The plasmodium is yellow, at least upon emergence, and passes almost without change to fruit. Found on rotten logs of every description, on the *lower* surface. In the Mississippi valley, the lower surface of planks used in the construction of sidewalks appears to be a favorite habitat.

Common west to the Rocky Mountains, south to Mexico and Nicaragua.

2. Hemitrichia karstenii *(Rost.) List.*

1876. *Hemiarcyria karstenii* Rost., *Mon., App.,* p. 41.
1891. *Hemiarcyria obscura* Rex, *Proc. Phil. Acad.,* p. 395.
1894. *Hemitrichia karstenii* Lister, *Mycetozoa,* p. 178.

Fructification plasmodiocarpous, with a tendency to form distinct sessile, globose sporangia, color brownish red; capillitium a sparingly branched network, with free ends few, the thread marked by

seven or eight faint spirals, the interspaces narrow, dull red in color, and 2.5 μ in diameter; spores yellow, delicately warted, 10–10.5 μ.

This is doubtless a very rare species. In the description we have followed Dr. Rex, *l. c.,* as being more to the point for American forms. It is not improbable that the American material may after all be distinct, as discrepancies, if one may judge by descriptions, are not few. Lister, who had a slide from Dr. Rex, considers the European and American forms the same.

In outward appearing, plasmodiocarpous phases of this species very closely resemble forms of *Licea* or *Ophiotheca,* and are in consequence often wrongly labeled.

Toronto; Montana—*Anderson.* To be looked for north and west.

3. Hemitrichia ovata (*Pers.*) *Macbr.*

1796. *Trichia ovata* Pers., *Obs. Myc.,* I., p. 61, and II., p. 35.
1863. *Trichia abietina* Wigand, *Pringsh. Jahr.,* III., p. 33, Tab. ii., Fig. 11.
1875. *Hemiarcyria wigandii* Rost., *Mon.,* p. 167.

Sporangia crowded or sometimes closely gregarious, subglobose or turbinate, shining yellow, sessile, the peridium thin, iridescent; capillitium a tangle of sparingly branched yellow or ochraceous-yellow threads, rather slender, 3–5 μ, marked by one or two prominent spiral bands forming a loose somewhat irregular spiral, the free ends not infrequent, inflated and rounded; spore-mass yellow or yellow-ochraceous, spores by transmitted light pale yellow, distinctly and sharply spinulose, but not netted, 10–11 μ.

A rare and beautiful species, distinguished well by the small size, about .5 mm., by the thin iridescent peridium, as by the microscopic characters of the capillitial threads.

There is no doubt that this is Persoon's *Trichia ovata.* His description is accurate in all that pertains to external features, and Rostafinski, *App.,* p. 41, explicitly says that he *saw* in Persoon's herbarium specimens of the species bearing the name cited. Just why Rostafinski did not here adopt the older name is not clear, nor is there excuse for abandoning Wigand's name were Persoon's invalid. According to Lister, *Trichia nana* Mass., from Maine, is the same thing. Persoon, *l. c.*, gives a synonymy which, in the nature of case, is unverifiable, the specific characters being microscopic.

Fries, *Syst. Myc.*, III., p. 187, confirms Persoon and takes pains to say that the color separates it from *T. chrysosperma* with which it is sometimes compared.

Rare. Maine, Massachusetts, New York, Ohio, Toronto.

4. Hemitrichia vesparium (*Batsch*) *Macbr.*

Plate III., Figs. 2 and 2 *a*.

1786. *Lycoperdon vesparium* Batsch, *Elench. Fung.*, pp. 255, 256, Fig. 172.
1794. *Trichia rubiformis* Pers., *Röm. N. Bot. Mag.*, I., p. 88.
1875. *Hemiarcyria rubiformis* (Pers.) *Rost., Mon.*, p. 262.

Sporangia clustered or crowded, rarely single, clavate or subcylindric stipitate or sessile, dark wine-red or red-black in color, the peridium in perfect specimens glossy or shining metallic, opaque; stipes solid, usually blent together, concolorous; capillitium of intertwisted slender threads, sparingly branched, marked by three or four spiral ridges, abundantly spinulose, the free tips also acuminate, terminating in a spine, the whole mass dull red. Spore-mass brownish-red, spores by transmitted light reddish-orange, very distinctly warted, subglobose, 10–12 μ.

A most common species, on rotten wood everywhere, especially in forests. Recognized generally at sight by its color and fasciculate habit. The peridium shows a tendency, often, to circumscissle dehiscence, and persists long after the contents have been dissipated, in this condition suggesting the name applied by Batsch, *vesparium*, wasp-nest. The capillitium is remarkably spinescent, the branching of the threads, rare. Rostafinski describes the spores as smooth; they seem to be uniformily distinctly warted. The plasmodium is deep red, and a plasmodiocarpous fructification occasionally appears.

Throughout the whole range, New England to Washington and Oregon, south to Nicaragua; Toronto.

5. Hemitrichia stipata (*Schw.*) *Macbr.*

Plate I., Figs. 8, 8 *a*, 8 *b*.

1834. *Leangium stipatum* Schw., *N. A. F.*, p. 258, No. 2304.
1876. *Hemiarcyria stipata* (Schw.) *Rost., Mon. App.*, pp. 41, 42.
1894. *Arcyria stipata* (Schw.) Lister, *Mon. Mycetozoa*, p. 189.

Sporangia distinct, crowded, cylindric or irregular, overlying one another, rich copper-colored, metallic, shining, becoming brown, stipitate; peridium thin, the upper portion early evanescent, the base persistent as a cup, as in *Arcyria;* capillitium concolorous, the thread abundantly branched to form a loose net, with many free and bulbous ends, pale under the lens, marked by three or four somewhat obscure spiral bands and a few wart-like or plate-like thickenings; stipe very short; spore-mass reddish, spores by transmitted light pale, nearly or quite smooth, 6–8 μ.

This species is known at sight by its peculiarly beautiful tint when fresh, as by the crowded prolix habit of the singular overlying sporangia. The netted capillitium and the evanescent peridium suggests *Arycria,* but there are abundant free tips, and the threads are unmistakably spirally wound, especially in the large, handsome sporangia characteristic of the Mississippi valley. It is a boundary form unquestionably. The stipe is generally very short, about one-tenth the total height; sometimes, when the peridium is more globose, the stipe is proportionally longer. Specimens from Iowa show fructifications several centimetres long and wide.

Not rare. New England to the Black Hills and south.

6. Hemitrichia leiocarpa (Cke.) *Macbr.*

1877. *Hemiarcyria leiocarpa* Cke., *Ann. Lyc. Nat. Hist. N. Y.,* XI., p. 405.
1891. *Hemiarcyria varneyi* Rex, *Proc. Phil. Acad.,* p. 396.

Sporangia simple, obovate or pyriform, rarely almost globose, pallid, with a stem of the same color, as long as the diameter of the sporangium; spore-mass and capillitium concolorous, or with slight ochraceous tint; capillitium forming a loose net, the tubes branching in a reticulate manner; spirals three, thin, prominent, along the convex sides of the tubes mixed with a few obtuse spines; spores globose, with a thin membrane, 12–14 μ.

Such is the original description of this distinctly American species. *H. varneyi* Rex should differ in having spirals seven or eight, and spore only 6.25 μ. Mr. Lister, who has compared types of both species, declares them the same! The present writer has been unable to secure authentic specimens.

Pennsylvania.

7. Hemitrichia intorta *List.*

1891. *Hemiarcyria intorta* Lister, *Jour. Bot.,* p. 268.
1891. *Hemiarcyria longifila* Rex, *Proc. Phil Acad.,* p. 396.
1894. *Hemitrichia intorta* List., *Mycetozoa,* p. 176.

Sporangia gregarious, globose-turbinate or pyriform, golden-yellow, stipitate; peridium thin, translucent, shining, opening at the summit irregularly, leaving a funnel-shaped receptacle below; stipe dark red brown, solid, rugulose; capillitium of threads sparingly branched, but looped and doubled upon themselves and constantly intertwisted, orange-yellow, 3–4 μ in diameter, with spirals four, sparingly spinulose, even and regular, the longitudinal striæ conspicuous; spores in mass concolorous, under the lens yellow, delicately warted, globose, 9–10 μ.

Concerning this species, Dr. Rex says: "Externally this species resembles *H. clavata* Pers., and has probably often been mistaken for it. The capillitium, however, in its structural details and habit of growth, is widely different. The partial untwisting of the loops of the capillitium by drying, after the rupture of the sporangium, causes it to be projected and elongated sometimes two or three times the length of the sporangium." Outwardly the open sporangium, by the projecting free tips, reminds one of a trichia. The capillitium is like that of *H. vesparium,* but less rough, and, of course, different in color.

Rare. Fairmount Park, Philadelphia; Ohio, Iowa.

8. Hemitrichia clavata (*Pers.*) *Rost.*

Plate III., Figs. 1, 1 *b*.

1794. *Trichia clavata* Pers., *Röm. N. Bot. Mag.,* I., p. 90.
1873. *Hemitrichia clavata* Pers., Rost., *Versuch,* p. 14.
1875. *Hemiarcyria clavata* (Pers.) Rost., *Mon.,* p. 264.
1893. *Hemiarcyria ablata* Morg., *Jour. Cin. Soc.,* p. 30.
1893. *Hemiarcyria funalis* Morg., *Jour Cin. Soc.,* p. 32.

Sporangia clavate or turbinate, gregarious, scattered or crowded, yellow, olivaceous or brownish, stipitate; the peridium generally thin, evanescent above, breaking away so as to leave a more or less definite cup beneath; stipe about one-half the total height, reddish, reddish-brown, or blackish, hollow about half-way down; capillitium various,

yellow or ochraceous, made up of slender threads more or less freely branched and netted, bearing four or five regular, even, spiral plates which project sharply and are generally smooth, the free extremities numerous or almost none, swollen, or simply obtuse; spore-mass concolorous, spores by transmitted light pale yellow, globose, minutely but distinctly warted, 8–9 μ.

This cosmopolitan species is generally one of the first brought in by the collector, its color and comparatively large size, 2–3 mm. high, making it conspicuous. Nevertheless, we are not able to recognize it in the descriptions of the older authors. Rostafinski quotes Schmiedel, *Icones,* 1776, as affording the earliest account of the species, but neither his description nor figure is definitive. Even Bulliard fails us here, and is differently interpreted by different authors. Persoon's description is none too good, but is reënforced by Fries and Rostafinski. The capillitium is variable both in the degree of smoothness presented, and the number of free ends, and the amount of branching. The spores in all specimens we have examined are remarkably constant in size and surface. In typical specimens free ends are easily discoverable, the branching forms a definite net, and the perfectly formed capillitial thread is smooth. In some American forms— developed under less favorable circumstances?— the net is less determined, the free ends are many, and the spirals minutely rough. Here may be placed *H. funalis* Morgan, *l. c.*

Widely distributed. New England to Colorado, south to Mexico.

9. Hemitrichia stipitata (*Mass.*) *Macbr.*

1889. *Hemiarcyria stipitata* Mass., *Jour. Mic. Soc.,* p. 354.
1893. *Hemiarcyria plumosa,* Morg., *Jour. Cin. Soc.,* p. 29.

Sporangia scattered, seldom crowded, obovoid or turbinate, olivaceous yellow, stipitate; the peridium smooth without, granulose within, evanescent above, persisting as a funnel-shaped cup below; the stipe long, reddish or blackish, rising from a small hypothallus; capillitium of threads 5–6 μ thick, very much branched, forming a dense net, free ends none, or not evident; the sculpture as in *H. clavata,* smooth and regular; spore-mass yellow; spores by transmitted light yellow, minutely warted, 7–8 μ.

This form corresponds in nearly every respect with *H clavata,*

except in the structure of the capillitium. The color is rather ochraceous, dirty yellow, and the stipe is proportionally longer and darker, but the form of the net is positive and gives to the species a decidedly striking and unique appearance, so that it may be recognized by the naked eye. It looks like an arcyria and for this reason Professor Morgan said *H. plumosa.* Lister regards it as the same as our number 8.

Common. Ohio, Illinois, Missouri, Iowa, and west; south to Mexico.

10. Hemitrichia montana *Morgan.*

Sporangia scattered or gregarious more or less closely, globose, whitish, sessile or very short stipitate; the peridium opaque, dull white, persistent below; capillitium deep yellow, the threads abundantly branched, forming a compact network, 7 μ wide, bearing spirals five or six, uneven and irregular, or anon interrupted, conspicuously spinulose or warted, free tips not lacking, generally inflated; sporemass yellow, spores by transmitted light pale, nearly colorless, distinctly warted, 10 μ.

Recognizable by its peculiar pallid, sessile sporangia, as by the internal structure. Perhaps related to *Hemiarcyria bucknalli* Mass. Our specimens are from Mr. Morgan, of Ohio, with the statement that they were collected in the San Bernardino Mountains, California, by Mr. S. B. Parrish; collected later from Monterey south.

Common throughout south-western states to lower California.

2. Calonema *Morgan.*

1893. *Calonema* Morgan, *Jour. Cin. Soc.,* p. 33.

Sporangia sub-globose, crowded or superimposed, irregular sessile; hypothallus none; capillitium of slender tubules, arising from the sporangium base, branched, marked with branching veins in an irregular reticulation, and terminating in free extremities. Spores yellow.

1. Calonema aureum *Morgan.*

Plate XIII., Figs. 2, 2 *a*, 2 *b*, 2 *c*.

1893. *Calonema aureum* Morgan, *l. c.*

Sporangia crowded or heaped in scattered clusters; peridium thin, golden yellow, adorned with intricate radiating veinlets capillitium of threads more or less branched, attached below, free above, the surface to the very tips venulose, interrupted with rings or fragmentary spirals, the apices bulbous and obtusely conical; spore-mass yellow, spores by transmitted light bright yellow, covered by a network of interlocking plates, as in *T. favoginea,* globose, 14–16 μ.

A curious form, related to *Hemitrichia,* much as *Oligonema* is to *Trichia.* Related to both the genera first named, but distinct, in the peculiar sculpture, from *Hemitrichia,* and from *Oligonema* in that the threads are not entirely free. Professor Morgan's original determination, founded on Ohio materials is confirmed by material sent us by Professor Underwood from Alabama.

3. Trichia (*Haller*) *Rost.*

1768. *Trichia* Haller, *Hist. Stirp. Helv.,* III., p. 114, in part.,
1875. *Trichia* (Haller) Rost., *Mon.,* p. 243.

Sporangia distinct, sessile or stipitate; capillitium of distinct elastic threads, free acuminate at each end, yellow or more rarely reddish or brown; spores generally yellow.

The trichias are easily recognized among their kind by their beautiful spirally wound, elastic capillitial threads, the *elaters;* these are entirely free, about 3–4 mm. in length, simple or only rarely branched, and generally acute at each extremity. The spiral bands, sometimes called *taeniae,* are generally very uniform in thickness, distance from each other, and pitch, and in many species are further reënforced by minute longitudinal plications running from one spiral to the next. Furthermore, the spirals may be smooth or spinulose the elater uniform throughout or enlarged betimes by nodes and swellings. Taken altogether, the trichias with the species of the genus next following exhibit the highest degree of differentiation attained by the Myxomycetes.

Most of the earlier authors, including Haller, used the generic name *Trichia* to cover a variety of forms. It is here used with the limits sketched by De Bary in 1859 and 1864 (*Die Myxomyceten*), and followed more exactly ten years later by his pupil, Rostafinski.

Key to the Species of Trichia

A. Sporangia, in typical cases at least, wholly sessile.
- *a.* Gregarious; hypothallus none.
  - i. Peridium brown or reddish brown.
    - * Elaters smooth.
      - † Spirals even, regular . . . 1. *T. inconspicua*
      - †† Spirals irregular . . . 2. *T. contorta*
    - ** Elaters rough, spinescent . . 3. *T. iowensis*
  - ii Peridium olivaceous or yellow.
    - * Elaters smooth . . . . . 4. *T. varia*
- *b.* Hypothallus distinct; sporangia crowded; spores reticulate, banded, or netted.
  - i. Spore-bands pitted . . . . 6. *T. persimilis*
  - ii. Spore-bands, narrow, plain . . . 7. *T. favoginea*
  - iii. Spores covered by a delicate net . . 5. *T. scabra*

B. Sporangia stipitate.
- *a.* Hypothallus distinct . . . . . 8. *T. verrucosa*
- *b.* Hypothallus none; peridium checkered with pale reticulations.
  - i. Brownish red or black . . . . 10. *T. botrytis*
  - ii. Olivaceous.
    - * Elaters smooth . . . . 11. *T. subfusca*
    - ** Elaters rough . . . . . 12. *T. erecta*
- *c.* Peridium plain, shining . . . . . 13. *T. decipiens*
- *d.* Peridium plain, dull black . . . . 14. *T. lateritia*

1. TRICHIA INCONSPICUA *Rostafinski.*

PLATE III., Figs. 5, 5 *a*, 5 *b*.

1875. *Trichia inconspicua* Rost., *Mon.*, p. 259.

Sporangia gregarious or crowded, small, spherical, ellipsoidal or arcuate, brown or reddish brown, sessile; hypothallus none; capillitium dull, dark, ochraceous, the elaters long, slender, even, about 3 μ wide, the spirals three or four rather closely wound, the apices attenuate, acute, sometimes turned to one side; spore-mass concolorous, spores pale ochraceous, minutely but distinctly warted, 10–12 μ.

One of the smallest of the *Trichiae,* not uncommon in the Mississippi valley on decaying fallen stems of *Populus*—sp. Distinguished at sight from all except No. 3 following, by its small size and brown color. Under the lens the long, delicate, finely sculptured capillitial threads, with fine tapering threads are distinctive.

New England, New York, Pennsylvania, Illinois, Iowa, Missouri, Nebraska; Black Hills, South Dakota; Toronto.

2. Trichia contorta (*Ditmar*) *Rost.*

Plate XIII., Figs. 7, 7 *a*.

1811. *Lycogala contortum* Ditmar, Sturm, *Deutsch. Fl.* III., Tab. 5.
1872. *Trichia reniformis* Peck., *Rep. N. Y. Mus.*, XXVI., p. 74.
1875. *Trichia contorta* Rost., *Mon.*, p 259.

Sporangia gregarious, or crowded, small, ellipsoid or reniform, arcuate, dark red brown, sessile; hypothallus none; capillitial mass ochraceous or dull yellow, the elaters few, irregular, the spirals uneven, irregular, often projecting and thin, though generally flat or obscure, the apices more or less swollen, ending in a curved tip; spore-mass concolorous, spores beneath the lens bright yellow, papillose, 10–12 μ.

This species resembles the preceding in color, but is of less aggregate habit, and the sporangia are more plasmodiocarpous, reniform, arcuate, etc. The capillitium is also distinctive, the sculpture irregular, uneven with general lack of symmetry. Our description is made up from specimens of *T. reniformis* Peck, which appears to be the American form of Rostafinski's species.

Rare. New York, Montana?

3. Trichia iowenis *Macbr.*

Plate III., Figs. 3, 3 *a*, 3 *b*; Plate X., Fig. 5.

1892. *Trichia iowensis* Macbr., *Ia., Bull. Lab. Nat. Hist.*, II., p. 133.

Sporangia sessile, gregarious, spherical or reniform, with no hypothallus, purple brown; spores and spore-mass yellow; elaters with three or four spiral bands unevenly distributed, and with occasional inflations, sparingly branched, spinulose, especially where inflated, spinules long, 3–6 μ, recurved, often bifid or trifid, especially at or near the acuminate tip; spores delicately warted, 9–11 μ.

This species occurs not rarely and is found on the bark of *Populus*, so far, exclusively. The sporangia are inconspicuous until opening by fissure they display the yellow spores and capillitial threads. The species is immediately recognized by its elaters, whose numerous and lengthened spinules are unlike those of any cognate form, reminding one of the capillitium of *Ophiotheca*. Related to the two preceding, but distinct by its spinulose capillitium.

Iowa, Missouri; Black Hills, South Dakota.

Trichia andersoni Rex carefully described by Morgan, *Myx. Mi. Val.*, p. 38, belongs with this first group, four small species, the inconspicuous. To the present writer in each the structure seems distinct. In the herbarium a small bit of Anderson's material has rested long; but it must not be lost to sight. The species is sure to be taken again in the cool mountains, somewhere abundant; as these stretch from Alberta to far Alaska. The capillitium is very even the taeniae closely wound, the elater-ends often furcate.

4. Trichia varia (*Pers.*) *Rost.*

Plate IV., Figs. 3, 3 *a*, 3 *b*.

1791. *Stemonitis varia* Pers., Gmel., *Syst. Nat.*, II., 1470.
1794. *Trichia varia* Pers., *Röm. Neu. Mag. Bot.*, I., p. 90.
1829. *Trichia varia* (Pers.) Fries, *Syst. Myc.*, III., p. 188.
1875. *Trichia varia* (Pers.) Rost., *Mon.*, p. 251.

Sporangia gregarious or sometimes closely crowded, globose, obovoid, or irregularly globoid, yellowish or ochraceous, shining, sessile, or with a short black stipe; hypothallus none; capillitium of rather long, simple, or more rarely branched elaters, 4–5 μ, wide, marked by irregular spirals generally only two, prominent and narrow and in places remote, the apices acute, about twice the elater diameter; spore-mass yellow, spores by transmitted light dull yellow, 12–14 μ, delicately verruculose, guttulate.

A very common species, very variable in form, stipitate forms occuring anon beside those which are irregular and sessile. According to Rostafinski the stipitate phase constitutes the *T. nigripes* of Persoon and other authors. The capillitium is, however, characteristic throughout. The two spiral bands wind loosely and irregularly and present an elater unlike anything else in the group except the same structure in *T. contorta,* but here the elater is narrow and the sculpture obscure. Since the specific distinctions are purely microscopic, the synonymy beyond Rostafinski is mainly conjectural. It is possible that Fries properly applied the name.

Common. Maine to Oregon and California, and south to Arkansas and Alabama.

5. TRICHIA SCABRA Rost.

PLATE IV., Figs. 4, 4 *a*, 4 *b*.

1875. *Trichia scabra* Rost., *Mon.*, p. 258.

Sporangia closely crowded upon a well-developed hypothallus, regular, globose or turbinate-globose, orange or golden brown, smooth, shining; capillitial mass clear, golden yellow, or sometimes rusty orange, the elaters simple, long, 4–5 μ in width, the spirals three or four, closely wound, spinulose, even and regular, the apices short, acuminate; spore-mass concolorous, under the lens spores yellow, covered by a delicate fine-meshed network, or simply spinulose under low power, 10–12 μ.

Generally a well-marked species, easily recognized by its regular but roughened capillitial threads. Under a 1-12 objective the spores are also diagnostic. To the unaided eye it resembles the next species in both color and habit. Fructifications two inches or more in length and half as wide are not infrequent on the lower side of fallen stems in forests of deciduous trees. The plasmodium is white.

Not uncommon. Maine to Washington, Oregon, Alaska, and south to Missouri and Arkansas.

6. TRICHIA PERSIMILIS *Karst.*

PLATE IV., Figs. 1, 1 *a*, 1 *b*, 1 *c*; 6, 6 *a*, 6 *b*, 6 *c*, 6 *d*.

1868. *Trichia persimilis* Karst., *Not. Saellsk. Fenn. Förh.* IX., p. 353.
1869. *Trichia affinis* De Bary, *Fuckel, Sym. Myc.*, p. 336.
1875. *Trichia jackii* Rost., *Mon.*, p. 258.
1877. *Trichia abrupta* Cke., *Myxom. U. S.* p. 404.
1878. *Trichia proximella* Karst., *Myc. Fenn.*, IV., p. 139.

Sporangia globose or obovoid or irregularly spherical, shining, golden yellow to tawny, anon iridescent with metallic lustre, sessile; hypothallus thin, but usually very distinct; capillitial mass ochraceous or tawny yellow, the elaters long, even, about 4 μ wide, the spirals four, more or less spinulose, generally joined by longitudinal ridges, the apices short, tapering regularly, anon bifurcate; spore-mass concolorous, spores by transmitted light bright yellow, marked by an irregular or fragmentary banded reticulation, the bands broad, flat, and pitted, 10–12 μ. Plasmodium said to be white.

This species, common throughout the northern world, is distinguished from its congener, the following, not only by the episporic character, but generally by its different peridium and more sombre colors. It never shows at maturity the brilliant golden yellow fluff that hangs in masses about the open and empty vases of *T. favoginea,* a fact not unnoted by Batsch, and rendering his figure and description so far determinable.

The episporic network shows all degrees of perfection or imperfection, and the elater also varies somewhat both in the apices and distinctness of longitudinal striæ. The several synonyms listed seem to have taken origin in a recognition of some of the more pronounced variations. In any event the American form *T. abrupta* Cke., with bifid apices, belongs here, and European specimens seem to show the identity of forms described by Karsten and De Bary.

Not rare. New England, Canada, New York, Pennsylvania, Ohio, Alabama, Missouri, and west.

7. Trichia favoginea (*Batsch*) *Pers.*

Plate IV., Figs. 5, 5 *a*, 5 *b*.

1786. *Lycoperdon favogineum* Batsch, *Elench. Fung.*, p. 257, Fig 173, *a, b.*
1791. *Sphaerocarpus chrysospermus* Bull., *Cham. de Fr.*, Tab. 417, Fig. 4.
1794. *Trichia favoginea* (Batsch) Pers., *Röm. N. Mag. Bot.*, I., p. 90.
1875. *Trichia chrysosperma* (Bull.) Rost., *Mon.*, p. 255.

Sporangia closely crowded, cylindric or prismatic by mutual pressure, obovoid, sessile, olivaceous yellow, smooth and shining; the peridium thin, opening above somewhat stellately, persistent; capillitium golden yellow, escaping entirely from the peridia, and forming woolly masses above them, the threads long, even, beautifully sculptured, bearing spirals about four, usually smooth and connected by light longitudinal ridges, the apices short tapering, about equal to the width of the elater, 6–7 μ; spores concolorous, by transmitted light paler, but still bright yellow, the episporic net conspicuous, the bands narrow and high, not pitted nor fragmentary, in form irregularly globose, 12–14 μ. Plasmodium yellow.

A common and beautiful species recognizable at sight, after the peridia break, by the aggregate capillitium constantly in evidence

above the abandoned vasiform peridia. The figures of Bulliard are unsatisfactory, although the description he gives and the name he suggests, still current, may lead us to concede that he had our species before him. The spores are larger than in *T. persimilis,* and the episporic net different, the "border" wider. The plasmodium in the latitude of Iowa not uncommon in woods in June, after emerging passes into fruit in the laboratory in about forty-eight hours, and the rupture of the peridia follows presently. The hypothallus is quite distinct, extra-marginal, and in substance like to the peridial wall.

Not rare. Throughout the northern forests, Maine to Washington and Oregon, south to Alabama, Louisiana, Mexico.

8. Trichia verrucosa *Berk.*

1860. ***Trichia verrucosa, Fl. Tasm.,*** **II., p. 269.**

Sporangia pyriform, or obovoid, shining, ochraceous from the color of the contents, stipitate, more or less botryoid or connate; stipe twice the height of the spore-case, reddish brown, simple or consolidated with others, weak, inclined, or procumbent; hypothallus distinct; spore-mass ochraceous yellow, the elaters simple, with smooth tapering points, with spirals three or four, the spores beautifully and strongly reticulate, after the manner of the spores in the species preceding, with the meshes generally complete and always large, quite variable in size 12–16 μ.

Rostafinski quotes the species (*teste* Lister) from Chile. Specimens in the herbarium of the State University of Iowa are from Jalapa, Mexico, collected by Mr. C. L. Smith. The species may be therefore expected in the southern United States. Berkeley described it from Tasmania. *T. superba* Mass. from description would seen to be the same thing.

9. Trichia pulchella *Rex.*

1893. ***Trichia pulchella*** **Rex, *Proc. Phil. Acad.,* p. 366.**

Sporangia solitary or in groups of four or five, bright vitelline yellow, sessile; the peridium thin, transparent, opening irregularly above; hypothallus none; capillitium bright yellow, not emergent, the threads

narrow, 3–4 μ, wound with spirals three or four, more or less irregular, smooth, longitudinal ridges wanting, the apices rather long, acuminate, about twice the diameter of the elater, or anon clavate or even globose, bulbose at the tip and furnished with several stout spines; spore-mass concolorous; under the lens spores colorless, marked by a very feebly developed reticulation of *T. persimilis* type, but the bands narrow and, as shown by the narrow "border," low, meshes few and often imperfect, globose or sub-globose, about 12 μ.

The episporic characters of this species ally it to *T. persimilis* most nearly. The reticulations are possibly not more divergent from the typical form of that species than are the same features in some other forms there included. But in the present case, added to the episporic sculpture, we must reckon the peculiar capillitial thread, unlike that seen in either of the chrysospermatous forms, and the gregarious habit without hypothallus. These peculiarities seemed to Dr. Rex distinctive, and as they appear constant they may be left to separate the species.

10. Trichia botrytis *Persoon.*

Plate XIII., Figs. 8, 8 *a.*

1791. *Stemonitis botrytis* Pers., Gmel., *Syst. Nat.*, II., 1468.
1794. *Trichia botrytis* Pers., *Röm. N. Mag. Bot.*, I., p. 89.
1803. *Sphaerocarpus fragilis* Sowerby, *Eng. Fung.*, I., p. 279.
1829. *Trichia pyriformis* Fries, *Syst. Myc.*, III., p. 184.
1875. *Trichia fragilis* (Sow.) Rost., *Mon.*, p. 246.

Sporangia gregarious, scattered, sometimes combined in clusters, pyriform or turbinate, stipitate, red-purple or, ochraceous-brown the peridium breaking up irregularly, the dehiscence sometimes prefigured by pale reticulations on the surface; stipe solid, single, or united in clusters of five or more together, dark-colored, red or purple-brown, opaque; capillitium orange, ochraceous yellow, or even reddish brown, the threads simple or rarely branched, long-fusiform, about 4 μ thick at the centre, tapering gradually to the long acuminate, apiculate tips, spirals three or four, even, smooth, rather closely wound and traceable almost to the apex; spores concolorous in mass, under the lens pale, globose, more or less closely minutely warted but not reticulate, 10–12 μ.

A species remarkable for its variations in color. More commonly the unopened sporangia are opaque brown, by reason of a dense outer wall, and more frequently simple, or if compound, show but two or three united. The reddish variety, vinous or scarlet-black in color, is remarkably fasciate. Some clusters show twenty or more stipitate, globose sporangia, conjoined by their distinct but coherent stems. In such fruitings the sporangia are small, .5 mm. In the brown sporangia the dehiscence, as stated, is often definitely prefigured; in the multiple, red, obscurely, if at all. As presented in collections from the eastern United States, the two forms might well be disjoined. Persoon, however, discussed both together and so they remain.

Saccardo includes *Craterium floriforme* Schw. here.

By the descriptions of the earlier authors it is impossible to distinguish this from *H. vesparium* on the one hand, and *T. decipiens* on the other. *T. botrytis* Pers., *l. c.*, gives us first secure foothold. Fries discards Persoon's appellation as unsuitable and improperly applied, and takes up what he deems an older specific designation, *T. pyriformis* Leers. But Rostafinski is certain Leers had *A. punicea* in mind, and that other early names are equally ill-applied. Rostafinski rejects Persoon's names simply as not pertinent in every case. Massee examined the specimens of Léveillé, and finds them belonging here; but see our No. 14, *seq.*

Not common, but with wide range. Maine, Massachusetts, New York, Pennsylvania, Ohio, Colorado; Toronto.

11 TRICHIA SUBFUSCA *Rex.*

1890. *Trichia subfusca* Rex, *Proc. Phil. Acad.*, p. 192.

Sporangia gregarious, scattered, dull tawny brown, shading to dark brown below, about ½ mm. in diameter, globose, stipitate; stipe short, about equal to the sporangium, stout, brown or brownish black, rugulose, solid; capillitial mass bright straw color; the elaters long cylindrical, 3–4 μ wide, adorned with spirals four, which wind unevenly, are perfectly smooth, and terminate in abrupt tips about twice the diameter of the elater; spores yellow, under the lens yellow, minutely and closely warted, globose, 12 μ.

The spores of this species resemble closely those of the preceding, but the sporangium is at sight different in appearance and proportions and the capillitium not the same at all. The elaters are never fusiform, the apices always abrupt in their acumination, and the sculpture irregular and uneven. In form the elater resembles that of *T. scabra.* The description is drawn from specimens, *N. A. F.,* 2495, with which, however, specimens received from Dr. Rex and later collected exactly correspond.

The elaters of uniform diameter, the apices abruptly narrowed to a blunt point, turned to one side, will serve to distinguish this species from the whole *T. botrytis* group, some forms of which it outwardly resembles.

We have beautiful specimens from the shores of Puget Sound.

New York.

12. Trichia erecta *Rex*

1890. *Trichia erecta* Rex, *Proc. Phil. Acad.,* p. 193.

Sporangia gregarious, often in clusters of two or three together, but generally single, nut-brown, checkered with broad, conspicuous yellow dehiscence bands, globose, ½ mm. wide, stipitate, stipe double the sporangium, dark brown, solid; capillitial mass bright yellow, the elaters cylindric, 3–4 μ wide, terminating in apices short and smooth, adorned with spirals, four, coarsely spinulose, winding unevenly or even branching and so united to one another! spore-mass yellow, spores by transmitted light pale, globose, minutely warted, 12 μ.

Distinguished at sight by the peculiarly mottled peridium. *T. botrytis* in its ochraceous forms sometimes shows tendency to the same thing, but the checkered surface is here conspicuous. The elaters resemble those of the preceding form, but are remarkably rough.

Rare. Adirondacks, New York.

13. Trichia decipiens (*Pers.*) *Macbr.*

Plate IV., Figs. 2, 2 *a*, 2 *b*.

1793. *Lycoperdon pusillum* Hedwig, *Abh.,* I., p. 35, Tab. iii., Fig. 2.
1795. *Arcyria decipiens* Pers., *Ust. Ann. Bot.,* XV., p. 35.
1796. *Trichia fallax* Pers., *Obs. Myc.,* I., p. 59, etc.

Sporangia gregarious, sometimes closely so, sometimes scattered, turbinate, shining olive or olivaceous brown, stipitate; stipe generally elongate, concolorous above, dark brown below, hollow, *i. e.* filled with spore-like cells; capillitial mass yellowish or olivaceous yellow, the elaters perfectly smooth, long fusiform, tapering gradually to the long, slender taeniate apices, simple or often branched, adorned with spirals three, which wind evenly but somewhat distantly; spore-mass olivaceous or ochraceous, spores under the lens, pale, minutely delicately reticulate, 10–12 μ.

One of our largest and most common species, in form and size resembling *H. clavata,* but immediately distinguished by its color. The capillitium is like that of *T. botrytis,* but differs in the more open sculpture and the longer and smoother unwound tips. The episporic net is a constant character in all the specimens examined. This feature reminds of *T. scabra.*

This is, of course, our familiar *T. fallax* of all authors from Persoon down. The earliest unmistakable reference to this species is Hedwig, *l. c.* But Batsch, in 1789, had used the same combination to describe a real puff-ball, so that Hedwig's name was already a synonym. The specific name here adopted is next in point of priority, although Persoon discarded it the year following, substituting *fallax,* because he had mistaken the genus.

Not rare. New England, Toronto; west to the Black Hills and Washington, Oregon, California, south to the Carolinas and Kansas; Jalapa, Mexico.

14. Trichia lateritia *Lév.*

1846. *Trichia lateritia* Lév., *Ann. Sci. Nat. Bot.,* 3 V., p. 167.
1875. *Trichia lateritia* Lév., Rost., *Mon.,* p. 250.
1892. *Trichia fragilis* (Sow.) Rost., Mass., *Mon.,* p. 176.
1894. *Trichia botrytis* Pers. var. *lateritia* (Lév.) List., *Mon.,* p. 171.
1899. *Trichia botrytis* Pers., Macbr., *N. A. S.,* p. 216.
1911. *Trichia botrytis* Pers. var. *lateritia* (Lév.) List., *Mycetozoa, 2nd ed.,* p. 217.

Sporangia more or less closely gregarious, (*a*) simple globose-turbinate, dull black when dry, when moist generally with a vinous tinge, 1 mm. in diameter, stipitate. The stipe concolorous, rigid, erect, simple

even, 2–6 mm., or (*b*) multiple, several sporangia united by their pale brown or reddish-brown, striate, weak, closely adherent or united stems; hypothallus small or none; capillitial-mass bright brick-red cut-off from the stem-cavity, such as may be, and enclosed by a thick, firm opaque peridium, which opens above in fragmental or petaloid lobes, leaving a craterium-like cup below, to persist in flower-like fashion long after the contents have blown away; elaters fusiform, extremely long, to 50 μ; about 5 μ in width at the widest (middle) point, long acuminate, adorned with usually four clean-cut even, regular, taeniae, uniformly spaced and carried forward on the progressive acumination, almost to the smooth, straight spine-like point; spores in mass brick-red, by transmitted light, orange-brown almost smooth, 10–12 μ.

This showy and remarkable species is set out from *T. botrytis* Pers. with which it has been more or less closely associated, for several reasons. In the first place, it is easily recognized in the field, by its size, color, and structure. Often simple throughout a colony entire, nevertheless where the vegetative development has been stronger, simple and multiple fructifications may stand side by side, but the odd fasciation is generally limited to few sporangia, perhaps three or four, or at most, half a dozen. These fasciate forms generally shorter, or less erect. The elaters, so far as our observation goes, are the longest in the genus notable for their beautiful symmetry. The spores are larger than in the red forms of *T. botrytis* as usually presented, smoother and of different color.

We have also a geographic limitation. Taken to Paris first from southern Chile, it promises to be a Pacific coast species, found as it now has been in North America from San Diego, to Vancouver. In a deep forest near Monterey, California, a half-buried log showed one colony a meter in length and from six to twelve centimetres in width, hundreds of sporangia, each by gentlest explosion opening to display its tuft of bright-tinted wool, a patch of color visible from far.

4. Oligonema.

1875. *Oligonema* Rost., *Mon.*, p. 291.

Sporangia distinct, small, generally crowded together and superimposed; hypothallus none; capillitium scanty, the sculpture rudimentary

and imperfect, scattered rings or mere roughenings, sometimes imperfect or faint spirals; spores yellow.

The oligonemas are simply degenerate *Trichiae,* and show the vagaries usually to be noted in a passing type. They are difficult to define, and the species are indeed variable. Those here listed seem to offer constant features throughout our range.

Key to Species of Oligonema

A. Spores reticulate.
  a. Sporangia in broad effused patches . . 2. *O. brevifilum*
  b. Sporangia in small heaped clusters.
    i. Elaters roughened, no distinct rings or spirals, 1. *O. flavidum*
    ii. Elaters with scattered rings; sometimes faint spirals, 3. *O. nitens*
B. Spores warted . . . . . 4. *O. fulvum*

1. Oligonema flavidum (*Peck*) *Mass.*

1874. *Perichaena flavida* Peck, *Rep. N. Y. Mus.,* p. 76.
1892. *Oligonema flavidum* (Peck) Mass., *Mon.,* p. 171.

Sporangia crowded and superimposed, sessile in small masses or clusters 1 cm. or less, bright yellow, shining, the peridium thin but opaque, yellow; capillitium of long, slender tubules usually simple, anon branched, even, or with an occasional inflation, the sculpture confined to warts or small, distinct spinules, roughening more or less conspicuously the entire surface, the apices generally obtuse, anon apiculate; spore-mass yellow, spores under the lens pale yellow, irregularly globose, beautifully reticulate, the meshes large and few, as in *Trichia favoginea,* 12–14 μ.

This species is marked by its capillitium, which is abundant for the present genus. The threads are longer than in any other species, and not infrequently branched, smooth, or more commonly, very distinctly minutely spinulose throughout, no trace of rings or relief sculpture of any sort, the spirals, that are to be expected, very imperfect, if discernible at all. In habit the species resembles *O. nitens,* but the colonies are much larger, and the sporangia higher and larger, attaining 1 mm.

New England to Iowa and Nebraska; south to Alabama and Louisiana. Toronto; *Miss Currie.*

2. Oligonema brevifilum *Peck.*

Plate XX., Figs. 5, 5 *a.*

1878. *Oligonema brevifila* Peck, *Rep. N. Y. Mus.*, p. 42.

Sporangia small, cylindric, dull ochraceous-yellow, sessile closely crowded, sometimes superimposed, forming large, effused patches several centimetres in extent; capillitium exceedingly scant, consisting of nothing more than a few minute threads, very short, only three or four times the diameter of the spore, smooth, or without any definable sculpture, ochraceous; spore-mass dark ochraceous, under the lens the spores are brighter, marked with reticulations much as in other species of the genus, 10–12 μ.

Probably a variety of our No. 1, but constantly collected.

Separate, however, from the following also in color and habit. To the naked eye the fructification suggests *Trichia persimilis;* the color much the same, and the sporangia similarly congested. The peculiarly rudimentary condition of the capillitium is apparently also constant. Iowa specimens accord perfectly with those from New York.

Rare. New York, Ohio, Pennsylvania, North Carolina, Iowa, Missouri, Oregon, Washington, California; Vancouver Island.

3. Oligonema nitens (*Lib.*) *Rost.*

Plate II., Figs. 8, 8 *a*, 8 *b.*

1834. *Trichia nitens* Lib. *Pl. Cr. Ard.*, III., No. 227.
1875. *Oligonema nitens* (Lib.) Rost., *Mon.*, p. 291.
1883. *Trichia pusilla* Schroet., *Kr. Fl. Schl.*, III., p. 114.

Sporangia gathered in small, heaped clusters, irregularly spherical, bright straw-color, or yellow, sessile, superimposed, the peridium thin, smooth, shining; capillitium of short elaters, simple or branched, smooth, adorned with an occasional projecting ring, often with faint spiral sculpture spreading especially toward the apices, which are blunt or anon acute, the point sometimes flexed or bent to one side, never very long; spore-mass bright yellow, spores globose, beautifully reticulate, 12–14 μ.

Readily recognized at sight by its heaped, shining, or glistening sporangia. The capillitial threads are further definitive, and serve to distinguish it from everything else.

The range is wide, probably coextensive with the forests of the country. Specimens are before us from New England, Canada, Montana, and all intervening regions, and south to the Gulf of Mexico; California, Nevada,—*Prof. Bethel.* Yosemite, shores of Mirror Lake!

4. OLIGONEMA FULVUM *Morgan.*

1893. *Oligonema fulvum* Morgan, *Jour. Cin. Soc.*, p. 42.

Sporangia large, sub-globose, sessile, or crowded, more or less regular; the peridium tawny yellow, or olivaceous, very thin and fragile, iridescent; mass of capillitium and spores tawny-yellow, elaters simple or sometimes branched, very short, sometimes with thicker swollen portions, the surface marked with low smooth spirals, in places faint and obsolete, the extremities rounded and obtuse, usually with a minute apiculus; spores globose, minutely warted, 10–13 μ.

This species may be recognized by its tawny, irregular, more or less crowded sporangia. Under the lens the warted, not reticulate, spores are diagnostic. The elaters are quite constantly marked by imperfect spirals.

Our specimens are from the author of the species, and so far there are none reported from outside Ohio.

ADDENDA

a. This volume is as we see, a descriptive list of the various forms of the Myxomycetes in so far as these have come to the personal notice of the writer.

Each form is designated, as is usual in discussing objects of the sort, by a particular binomial name, followed, in abbreviated form, by the name of the student or author who in describing the form in question used the combination. Thus *Stemonitis splendens* was first described by Rostafinski, and the name he thus used is applicable to the form he described, wherever found, and to *nothing else*.

The proper naming of any specimen would thus appear to be a very simple matter. Such, however, is often not the case, particularly where we are concerned with species long familiar to science. Such often have received, at different times, and at the hands of the same author, or certainly of different authors, different names, given for various reasons; so that one who would refer to, or discuss, a single specimen to-day finds himself often in great uncertainty, confronted by a multitude of binomial combinations all thought to refer to the same particular thing.

By general consent, of course, we strive to ascertain the oldest name on the list; the first that is really and clearly applicable, and we write all other names down as synonyms. In this volume a list of synonyms often accompanies the description; precedes it, showing, year by year, the history of the case; an abstract in fact of the title, as at last approved. The preparation of such an abstract is very troublesome, but is believed to be worth the trouble; must be made, indeed, if we are ever in our discussions to be sure that when we speak or write in America, we are dealing with the same thing intended by the man who speaks or writes in England, or elsewhere.

The space occupied in synonymy, is therefore by no means wasted. By and by, if we succeed in establishing a nomenclature on which competent judges can agree, a thing not at all improbable, almost

now attained, the lists may gradually disappear as having historical value only.

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b. Taxonomy, in any field, is of necessity concerned with history. For his own sake, no student can ignore the thought and work of his predecessors. No man ever sees nature in completeness, nor even the small part of the world to which he devotes attention. He needs every possible assistance, especially the observations of intelligent men. The present author rejoices to acknowledge the assistance found in volumes written in Europe during the last two hundred years. Such men as Persoon, Bulliard, Schumacher, Schrader, Fries, are deservedly famous; they laid the foundations of mycologic taxonomy. No student can afford to miss *Elias Fries;* his genius, spirit and scholarship entitle him to the recognition and sympathy of every lover of the intellectual life.

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c. The considerations just mentioned may, indeed do, sometimes act as a handicap to the American student, for the simple reason that he comes later to the field of time. He must naturally defer to the decision of men in Europe who are supposedly familiar with original types. An American specimen is presumably the same as one occurring elsewhere in similar latitude and environment. It becomes evident after while that only in certain instances is this undoubtedly the fact. The flora of the American continent has been sufficiently disjoined in space and time from Europe to permit extensive differentiation even in these minor forms, so that we have indeed in the groups we study many species, some genera, definitely autochthonous, more it is believed than are now suspected. An attempt to bring a specimen under the terms of a species described in Western Europe is not seldom an error. It becomes evident, as we go forward, that in eastern North America there are forms not only not described in European literature, but really not, part of European flora, not even adventitiously.

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d. Many of the more minute species with which this volume has to do are very elusive, very difficult; for one reason,—perhaps in

itself sufficient,—because of their minuteness, and consequent apparent paucity. They may be common, but none the less seldom seen. The comatrichas afford an illustration. There are several very small species. *C. pulchella, C. laxa, C. ellisii* may be mentioned. *C. pulchella* has been studied nearly a hundred years and has a synonymy accordingly. In 1875 Rostafinski in the material, and among the descriptions, thought he recognized two distinct forms, and went on to give them names; the first in honor of Persoon, *C. persoonii,* should show an ovate or ovate-cylindric outline with acuminate tip; the second should be truncate and represent a type first described by Berkeley under a name given by Babington, *C. pulchella.* Berkeley's drawing shows a sporangium with tip acuminate! Lilac or violaceous tints attracted attention in the spores of *C. persoonii* only; in *C. pulchella* all is ferruginous. Curtis is especially commended for noticing the fact in describing *S. tenerrima,* here included as we see.

Comatricha gracilis Wing. is slender, cylindric and has small spores hardly reaching 6 μ; should perhaps be now set out as a separate species; it is evidently purely an American phase.

Our figures, Plate XII., 16 and 16 *a,* 18 and 18 *a,* show *C. pulchella* and *C. gracilis,* respectively, extremes. Plate XIII., 4, shows an ovate form not very unusual. This and *C. gracilis* occur on living leaves.

C. ellisii is another of this minor series, very constant in its delicate beauty, but approaches *C. nigra* rather than the others here discussed.

C. laxa, as the name implies, shows an open construction, suggested, perhaps, by Rostafinski's photographic print, but better brought out by Celakowsky, *Myx. Böhm.,* Tab. 2, Figs. 7 and 8.

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e. It has been shown[1] that the process of cell-division in the sporeplasm of the myxomycete is not dissimilar to that obtaining under the same conditions in higher plants. On this supposition we have explanation of spore-division in *Ceratiomyxa* and can understand the adherence of spores now and again notable. Once the latter phenomenon was thought peculiar to the genus *Badhamia;* but the un-

[1] Farr. *Cell-division in Pol. Mother-cells, Cobæa scandens, Bull. Tor. Bot. Cl.,* Vol. 47, pp. 325–38.

sculptured epispore of the spores of reticularias, tubiferas, etc., suggest the same thing and more recently we find it in *Dianema* and in the *Stemoniteae;* even *Stemonitis* arrives with clustered spores in groups of four, and we are in sight of a generalization wide.

It is interesting to note that something of this sort was observed by at least one student long ago. Schumacher, *Enum. Pl. Sell.* 2, p. 215, describes *Arcyria atra* with the characters of an enerthenema, and says "the capillitial threads are some of them diffuse and bear spermatic globules"! Did he anticipate *E. berkleyanum*? See the text under that species at p. 190, *supra.*

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f. In a paper read December, 1920, before the *Mycological* Division of Section G., *A. A. A. S.,* the present writer discussed briefly the physical principles involved in some of the more striking peculiarities of the slime-moulds.

It is argued in that paper that the shaping of stipitate sporangia which is so surprising as relating to the ordinary behaviour of fluid masses, as usually observed, is, in part at least, referable to certain well known properties of fluids generally. For this discussion those interested are referred to the article itself in the November number of *Mycologia* (N. Y.).

Sufficient to say here that it is a fact, in many cases, that in stipitate fructification, so far as observed, the stipe is first to take form, and, as viewed by the writer, in many cases, as it rises, becomes more and more a most delicate but definite ectosarcate capillary tubule, by which ascends the spore-plasm of the point concerned, to such level as may meet the immediate conditions of pressure, of whatsoever source.

It will be interesting in this view to note the resultant shapes as presented in the sporangia of various genera. One may examine for illustrations Figs. 1, 3, 4, 7, Pl. XX., with the thought in mind that the stipe in each case may have served as a capillary tubule to carry up the spore-plasm to the position in which the spores at length are found. In some species of *Hemitrichia,* for instance, there are spores or spore-like cells found at maturity in the hollow stipe. In other cases the stipe contains refuse matter.

The capillary theory may not, probably does not, play part in every case. It would seem that a stemonitis, for example, must owe the rise of the spore-plasm to the play of different machinery. *Brefeldia,* p. 154 above, may offer suggestion.

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g. On page two of the introductory section of this volume mention is made of the variety of colors shown in the vegetative phases of the organisms we study. This fact is patent to all observers; but the identity of the plasmodium making the display must be ascertained by painstaking or prolonged and repeated observations. This for the reason that, as I am convinced, only in comparatively few cases is the color unchanged during the life-history of a given fructification. It may sometimes change from hour to hour as development proceeds. The color designated in the descriptive pages of this work is presumably, unless as otherwise set out, that immediately preceding that of the maturing fruit.

As suggestive, and as, it is hoped, contributory to better knowledge of this phase of our subject a list of species is here subjoined as presented by my colleague, Professor Morton E. Peck of Oregon, who has given unusual attention to this particular investigation.

Species	Plasmodium Colors
Physarum sinuosum . . .	light grey, nearly white, ivory white
Physarum serpula	greenish-yellow; yellow
Physarum virescens . . .	pale greenish-yellow; yellow
Physarum cinereum . . .	watery grey, becoming white; pallid
Physarum didermoides . .	watery grey, becoming white; blue-white
Physarum notabile . . .	pure white
Physarum globuliferum . .	greenish-yellow; yellow
Physarum leucopus . . .	light grey
Physarum pulcherrimum .	dark red
Physarum flavicomum . .	greenish or brownish yellow
Physarum viride	clear yellow
Physarum wingatense . .	at first grey, then pure white
Badhamia orbiculata . . .	pale yellow, passing to white
Physarella oblonga . . .	brilliant yellow
Mucilago spongiosa . . .	watery grey, then white
Didymium crustaceum . .	white
Didymium squamulosum . .	pale grey, watery white
Diderma floriforme . . .	grey tinged with yellow
Stemonitis fusca	white passing through blue to black

Stemonitis smithii	green to yellow to reddish purple
Comatricha longa	white, cream-yellow, reddish purple to dusky
Comatricha irregularis . .	white
Comatricha nigra	white
Comatricha typhoides . .	bluish white
Diachaea splendens . . .	pure white
Enerthenema papillatum .	colorless or greenish
Reticularia lycoperdon . .	white
Dictydiaethalium plumbeum	colorless, pink, salmon, rose, orange, chocolate brown
Lindbladia effusa	brown, lead-colored
Tubifera ferruginosa . . .	watery white, scarlet, brown, almost black
Cribraria dictydioides . .	clear dark green
Cribraria tenella	watery, dark plumbeous, bronze
Cribraria cuprea	red
Arcyria nutans	white
Arcyria denudata	watery white, then flesh-color
Arcyria cinerea	grey, then white
Trichia varia	colorless, then white

h. In a few instances references to illustration do not find place in connection with the descriptive matter. One phase of *Physarum albescens* is figured on Pl. III.; *Mucilago* will be found portrayed on Pl. VII.; *Physarum viride* on Pl. VIII.

j. The group before us has research possibilities not a few. The question of their nutrition and its limits in respect of variety, is yet to be solved. From present indications all that can be said is to the effect that a pabulum similar in variety, no doubt meets the needs of many species. Whether in artificial culture a single base as gelatin or agar would suffice for all or several is yet to be discovered.

Whether a species brought from spore to maturity on artificial diet would conform in any reasonable way to our dim concept of its identity is also, it would seem, a problem. The variation in the field would seem to make it doubtful.

From the table immediately preceding it is plain that there is place for doubt. Color it is surmised is of itself everywhere incidental; the structure, which maintains identity or the reverse, lies

deeper, although color may be none the less, in some way a resultant, and therefore in so far a reliable taxonomic guide.

The treatment of our subject so far by no means exhausts the possibilities of even the simpler phases of microscopic study. We have endeavored to appreciate the work of those who hand us the literature of the group, and to recognize what such keen-eyed men have seen; but in our western and southern forests there are probably double as many species, as species go, as we have listed.

The entire group is, as it would seem, in highest measure worthy of investigation and comprehension, and should it at any time prove that to such accomplishment the present volume may have been in any smallest way contributory, the author's satisfaction will be complete indeed.

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GENERA

ALWISIA 208
Alwis; personal.

AMAUROCHÆTE 148
ἀμαυρός, dusky, and *χαίτη*, hair. Gr.

ARCYRIA 247
ἄρκυον a net. Gr.

BADHAMIA 313
C. D. Badham; personal.

BREFELDIA 154
O. Brefeld; personal.

CALONNEMA 266
καλός, beautiful, and *νῆμα*, a thread. Gr.

CERATIOMYXA 18
κεράτιον, a small horn, and *μύξα*, mucus. Gr.

CIENKOWSKIA 110
Leon Cienkowski; personal

CLASTODERMA 191
κλαστός, broken, and *δέρμα*, dermis, skin or covering. Gr.

COLLODERMA 147
κόλλα, glue, and *δέρμα*, dermis, covering.

COMATRICHA 171
κόμη, and *θριξ*, both words meaning hair. Gr.

CRATERIUM 103
κρᾶτήρ, a vessel. Gr.

CRIBRARIA 216
cribrum, a sieve. Lat.

DIACHAEA 185
διάχευ, to pour out; the application not patent. Gr.

DIANEMA 238
διὰ, through or across, and *νῆμα*, thread. Gr.

DICTYDIUM 230
δίκτῦον, a net. Gr.

DICTYDIÆTHALIUM 215
Dictydium and æthalium; the latter from *αἰθαλος*, sooty. Gr.

DIDERMA 129
δίς, twice or twofold, and *δέρμα*, as above. Gr.

DIDYMIUM 115
δίδυμος, double. Gr.

ECHINOSTELIUM 198
ἐχῖνος, a sea-urchin, and *στήλων*, (?), a handle or stem. Gr.

ENERTHENEMA 189
ἐνερθε, below, and *νῆμα*, a thread.

ENTERIDIUM 211
ἔντερον the intestine. Gr.

FULIGO 23
fuligo, soot. Lat.

Hemiarcyria 259
ἡμῖ, half, and Arcyria.

HEMITRICHIA 259
ἡμι, half, and Trichia.

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HETEROTRICHIA 256
ἕτερος, other, and Trichia.

LACHNOBOLUS 245
λάχνος, woolly, and *βῶλος*, a lump. Gr.

LAMPRODERMA 191
λαμπρός, shining, and *δέρμα*, as above. Gr.

LEOCARPUS 111
λεῖος, smooth, and *καρπός*, fruit. Gr.

LEPIDODERMA 144
λεπίς, a scale, and *δέπμα*, a covering. Gr.

LICEA 199
said to be Latin; *licium*, a thrum, a girdle.

LINDBLADIA 203
A. Lindblad; personal.

LYCOGALA 233
λύκος, a wolf, and *γάλα*, a, milk. Gr.

MARGARITA 237
μαργαρίτης, a pearl. Gr.

MUCILAGO 113
mucilago, musty juice. Lat.

OLIGONEMA 278
ὀλίγος, few, and *νῆμα*, a thread. Gr.

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OPHIOTHECA 240
ὄφις, a serpent, and *θήκη*, a case. Gr.

ORCADELLA 203
ὀρκά, a cask (?). Diminutive.

PERICHÆNA 242
περὶ, around, and *χαίνειν*, *to* crack open. Gr.

PHYSARUM 45
φῦσα, a bladder, something inflated.

PHYSARELLA 71
Diminutive of *Physarum.*

PLASMODIOPHORA 17
πλάσμα, something formed, and *φορός*, that bears. Gr.

PROTOTRICHIA 257
πρῶτος, first, and *Trichia.*

RETICULARIA 209
reticulum, a small net. Lat.

STEMONITIS 156
Like a stamen.

TILMADOCHE 95
τίλμα, lint, and *δοχή*, containing. Gr.

TRICHIA 267
θρίξ, hair. Gr.

TUBIFERA 205
tubus, a tube, and *fero*, I bear. Lat.

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PLATES

TO ILLUSTRATE

NORTH AMERICAN SLIME-MOULDS

Note.—Plates I., II., IV., VI., VII., VIII., IX., X., were originally by Miss Mary P. Macbride; Plates V., XI., XII., were by Mrs. Hattie J. Douglass; Plates XIII., XIV., XV., XVI., XVII., were by the late Mrs. Bertha E. Linder Pumphrey; Plate III. was the joint work of Mrs. Pumphrey and Miss Macbride. All these, except IV., have been re-drawn for new plates; XVI., with additions, by Miss Margaret Hayes; the remainder by Mr. W. J. Calvin, C. E. Plate XVIII. is by Miss Hayes; Plate XIX. by Miss A. M. Held; Plate XX. by Miss Jane Coventry.

EXPLANATION OF PLATE I

Enteridium splendens Morg., p. 211.

Fig. 1. Æthalium, natural size.
Fig. 1 *a*. Spore of the same species, × 1400.
Fig. 1 *b*. Capillitium of the same species, × 420.

Dictydiæthalium plumbeum (Fr.) Rost., p. 215.

Fig. 2. Æthalium, natural size.
Fig. 2 *a*. Sporangia and spores, × 50 (after Schroeter).
Fig. 2 *b*. Persistent apices of the peridia.

Lindbladia effusa (Ehr.) Rost., p. 204.

Fig. 3. A group of sporangia, × 30.
Fig. 3 *a*. A single spore, × 1400.

Tubifera ferruginosa (Batsch) Macbr., p. 206.

Fig. 4. A group of sporangia, × 5.
See also Plate VII., Fig. 8; and Plate XII., Fig. 14.

Cribraria dictydioides Cke. & Balf., p. 222.

Fig. 5. Three sporangia, × 15.
Fig. 5 *a*. A single sporangium, to show reticulate thickening, × 60.
Fig. 5 *b*. A spore, × 1400.

Dictydium cancellatum (Batsch) Macbr., p. 230.

Fig. 6. Sporangium, × 30.
Fig. 6 *a*. A part of the peridial wall, seen from within, × 84.

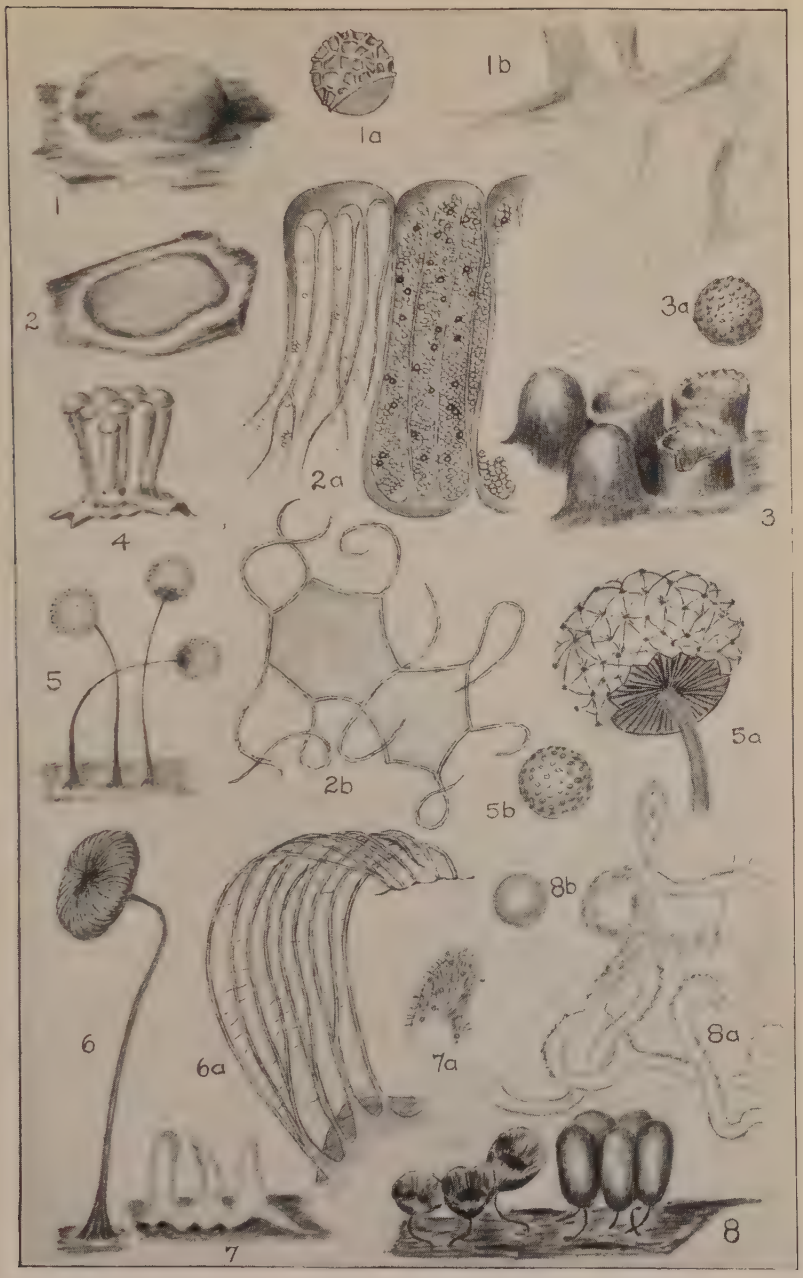
Ceratiomyxa fruticulosa (Muell.) Macbr., p. 19.

Fig. 7. Three sporiferous pillars, × about 40.
Fig. 7 *a*. Tip of a single pillar, × 84.

Hemitrichia stipata (Schw.) Macbr., p. 262.

Fig. 8. Sporangia, × 6.
Fig. 8 *a*. The capillitium of the same species, × 750.
Fig. 8 *b*. A single spore, × 1000.

PLATE I



EXPLANATION OF PLATE II

Perichaena corticalis (Batsch) Rost., p. 243.

Fig. 1. Sporangia, × 10.
Fig. 1 *a*. A single spore, as if in section, × 900.
Fig. 1 *b*. The capillitial thread, × 750.

Lachnobolus occidentalis Macbr., p. 246.

Fig. 2. The sporangia, × 8.
Fig. 2 *a*. A portion of the capillitium, × 750.
Fig. 2 *b*. Spores, × 750.
See also 4 and 4 *a* below.

Arcyria cinerea (Bull.) Pers., p. 254.

Fig. 3. The expanded fructifications, × 5.
Fig. 3 *a*. Tip of a single capillitium mass, × 40.

Lachnobolus occidentalis Macbr., p. 246.

Fig. 4. A cluster of sporangia, × 3; cylindric type.
Fig. 4 *a*. Capillitium, × 750; to show characteristic surface of the threads.

Arcyria denudata (Linn.) Pers., p. 253.

Fig. 5. Sporangia, two expanded, one still closed, × 20.
Fig. 5 *a*. A part of the capillitium of the same species, × 750.

Arcyria nutans (Bull.) Grev., p. 249.

Fig. 6. Expanded capillitium, etc., × 10.
Fig. 6 *a*. Capillitium, × 750.
Fig. 6 *b*. A piece of the capillitium thread, × 1400.

Ophiotheca wrightii Berk. & C., p. 241.

Fig. 7. A single sporangium, × 8.
Fig. 7 *a*. A node of the capillitial thread, × 750.
Fig. 7 *b*. A spore, × 750.

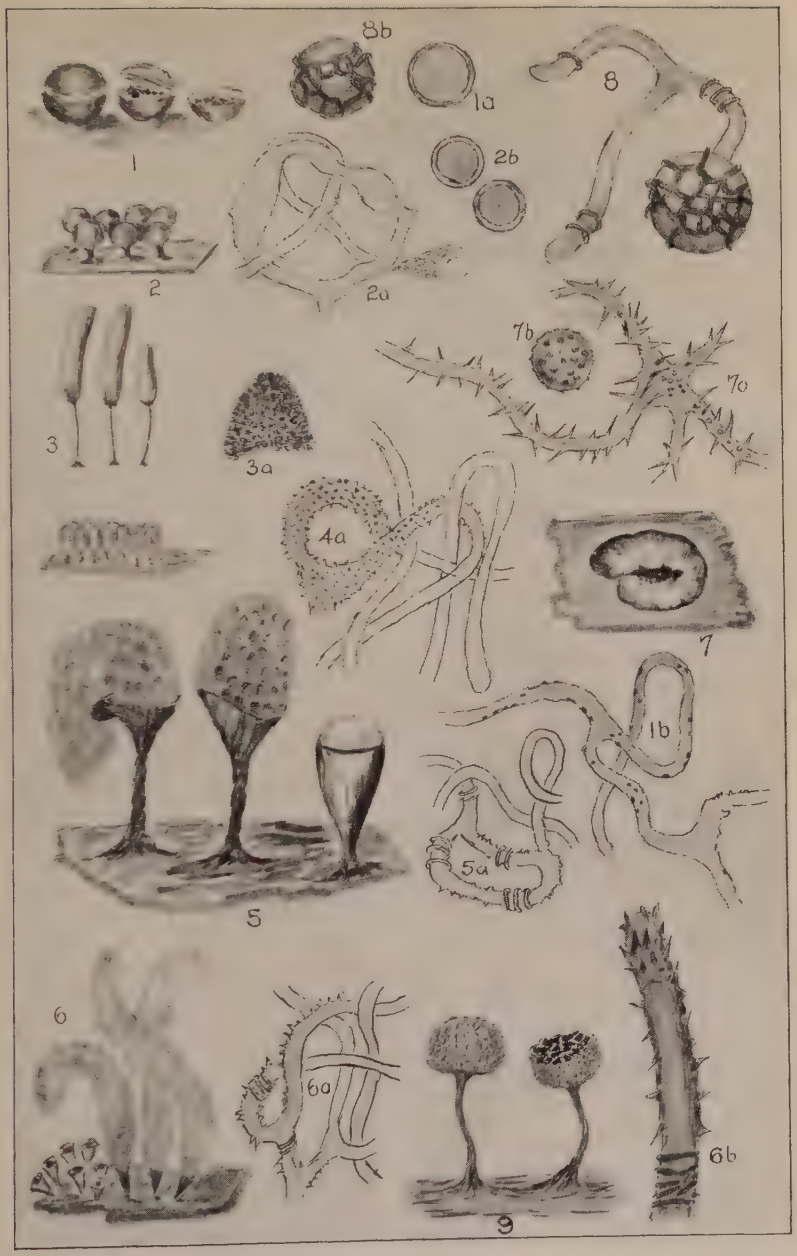
Oligonema nitens (Lib.) Rost., p. 280.

Fig. 8. A single elater, × 750.
Figs. 8 *a* and 8 *b*. Spores, × 1000.

Badhamia macrocarpa Rost., p. 7.
Var. *gracilis*.

Fig. 9. Two sporangia, × 600.

PLATE II



EXPLANATION OF PLATE III

Hemitrichia clavata (Pers.) Rost., p. 264.

Fig. 1. Three sporangia, one closed, × 8.
Fig. 1 *b*. A single spore, × 1400.

Hemitrichia vesparium (Batsch) Macbr., p. 262.

Fig. 2. Tip of the elater of capillitial thread, × 1400.
Fig. 2 *a*. A single spore, × 1400.

Trichia iowensis Macbr., p. 269.

Fig. 3. A cluster of sporangia, × 5.
Fig. 3 *a*. Tip of a branching elater, × 750.
Fig. 3 *b*. A single spore, × 750.
See also Plate X., Fig. 5.

Hemitrichia serpula Scop., p. 260.

Fig. 4. A plasmodiocarp, × 3.
Fig. 4 *a*. A single spore, × 1400.
Fig. 4 *b*. An elater-tip, × 1400.

Trichia inconspicua Rost., p. 268.

Fig. 5. A cluster of sporangia, × 12.
Fig. 5 *a*. Tip of an elater, × 1400.
Fig. 5 *b*. A single spore, × 750.

Physarum oblatum Macbr., p. 91.

Fig. 6. A single sporangium, × 20; stipe shown of unusual length.
Fig. 6 *a*. A single spore, × 1000.
See also Plate XIV., Fig. 3.

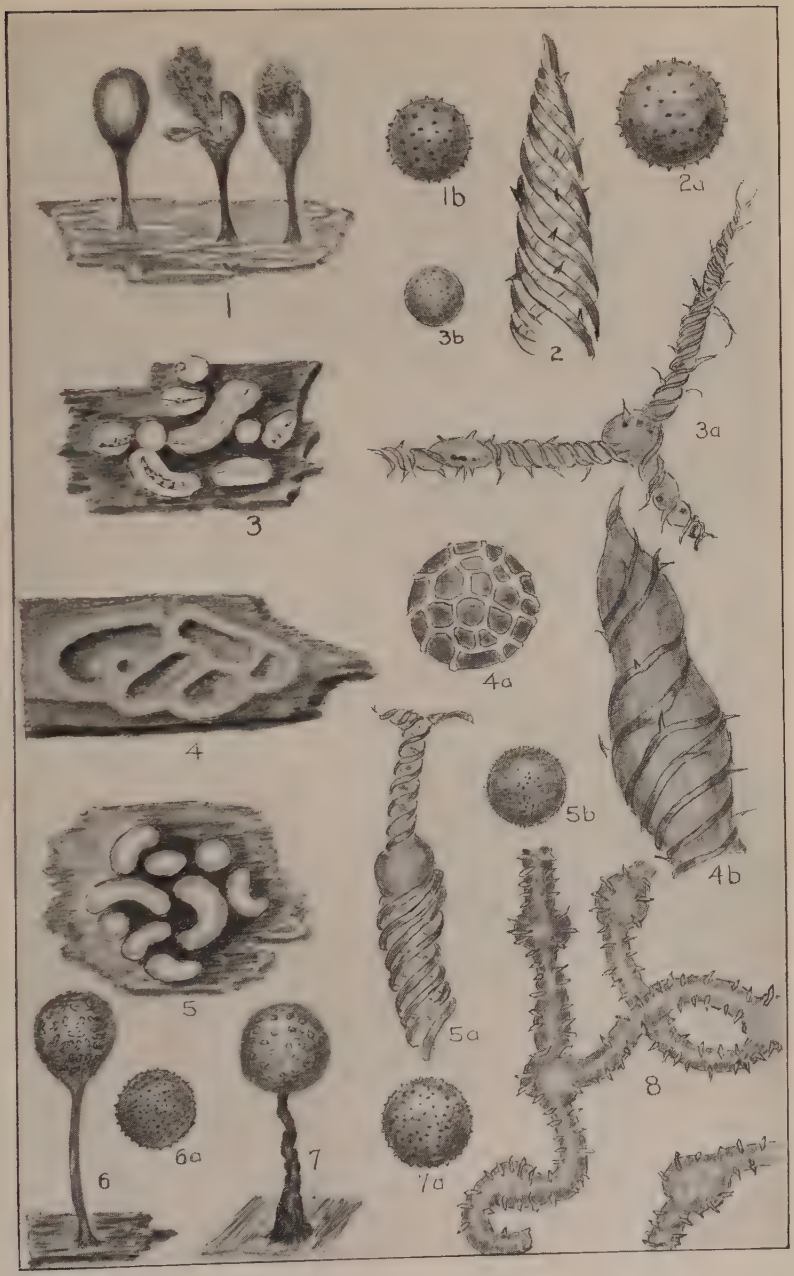
Physarum auriscalpium (Cke.) Lister, p. 90.

Fig. 7. A single sporangium, × 20; a New York specimen.
Fig. 7 *a*. A single spore, × 1000.

Arcyria nodulosa Macbr., p. 252.

Fig. 8. Capillitial thread, × 1200.

PLATE III



EXPLANATION OF PLATE IV

Trichia persimilis Karst., p. 271.

Fig. 1. Var. *intermedia,* × about 6.
Fig. 1 *a.* Spore of same species, × 1400.
Fig. 1 *b.* A second spore to show varying episporic network.
Fig. 1 *c.* Tip of elater, shows vertical connecting bands.

Trichia decipiens (Pers.) Macbr., p. 276.

Fig. 2. Sporangia, × about 8.
Fig. 2 *a.* A spore of the same species, × 1400.
Fig. 2 *b* and 2 *c.* Elaters of the same species, × about 225.

Trichia varia (Pers.) Rost., p. 270.

Fig. 3. Sporangia, × about 8.
Fig. 3 *a.* A spore of the same species, × 1000.
Fig. 3 *b.* An elater of the same species, × 750.

Trichia scabra Rost., p. 271.

Fig. 4. Sporangia, × about 8.
Fig. 4 *a.* A single spore of the same species, × 1400.
Fig. 4 *b.* An elater-tip of the same, × 1400.

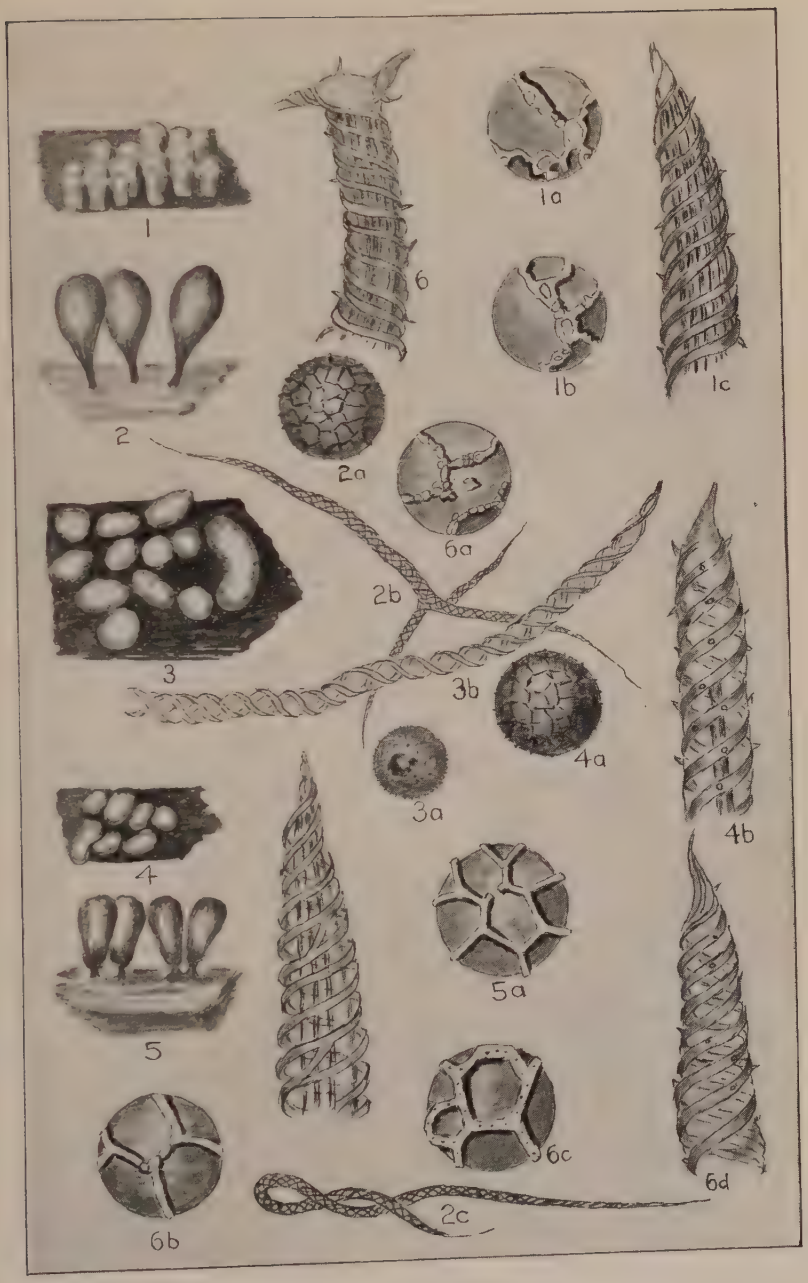
Trichia favoginea (Batsch) Pers., p. 272.

Fig. 5. Sporangia, × about 8.
Fig. 5 *a.* A single spore of the same, × 1400.
Fig. 5 *b.* A single elater-tip of the same, × 1400.

Trichia persimilis Karst., var *abrupta* Cke., p. 271.

Fig. 6. An elater-tip, × 1400. It will be noticed that the spirals are connected by vertical bars.
Fig. 6 *a.* A single spore of the same variety, × 1400.
Fig. 6 *b.* A single spore, from the same sporangium as 6 *a.*
Fig. 6 *c.* *Trichia persimilis,* a single spore, × 1400.
Fig. 6 *d.* Tip of an elater from the same, × 1400.

PLATE IV



EXPLANATION OF PLATE V

Lamproderma arcyrionema Rost., p. 197.

Fig. 1. A single sporangium seen as if in section, × 40.
Fig. 1 *a*. A single spore, × 1400.

Lamproderma scintillans (Berk. & Br.) List., p. 195.

Fig. 2. A single sporangium seen as in section, × 40.
Fig. 2 *a*. A single spore, × 1400.

Enerthenema papillatum (Pers.) Rost., p. 190.

Fig. 3. An expanded, blown-out sporangium, × 25.

Lamproderma robustum Ell. & Ev., p.

Fig. 4. A sporangium seen as in section, × 20.
Fig. 4 *a*. A single spore, × 1000.

Comatricha laxa Rost., p. 177.

Fig. 5. A sporangium seen as if in section, × 40.
Fig. 5 *a*. A single spore, × 2000.

Diachaea thomasii Rex, p. 188

Fig. 6. Three sporangia magnified about 15 times.
Fig. 6 *a*. A single spore of the same species, × 800.

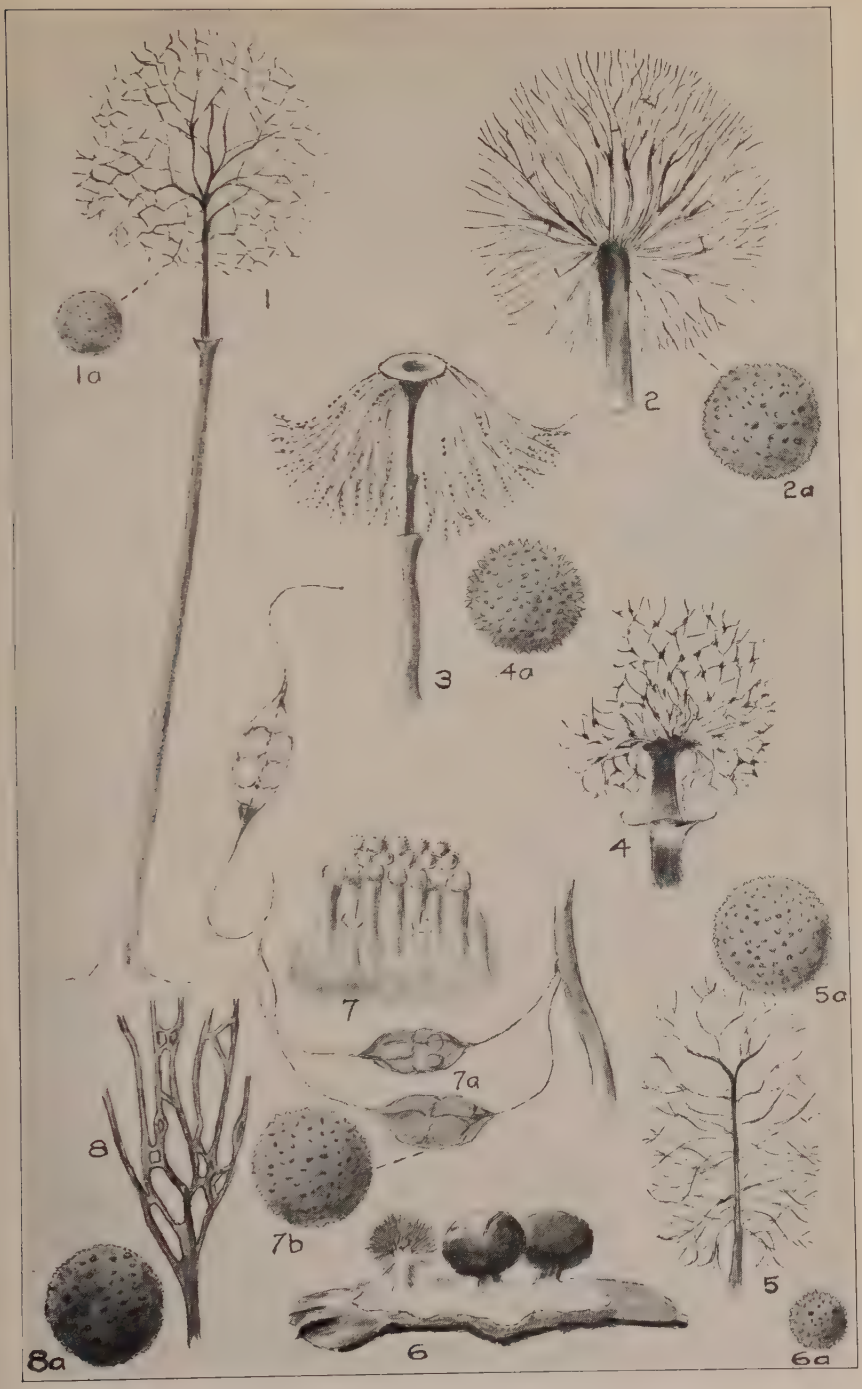
Brefeldia maxima (Fries) Rost., p. 154.

Fig. 7. A group of sporangia, showing columellæ; × 5.
Fig. 7 *a*. Capillitial threads of the same species, × 300.
Fig. 7 *b*. Spore of the same species, × 1500.

Amaurochæte fuliginosa (Sowb.) Macbr., p. 149.

Fig. 8. A bit of so-called capillitium, × 300.
Fig. 8 *a*. A single spore magnified about 1000 times.

PLATE V



EXPLANATION OF PLATE VI

Comatricha typhoides (Bull.) Rost., p. 181.

Fig. 1. A group of sporangia, × 5.
Fig. 1 *a*. A single spore, × 1600.
Fig. 1 *b*. Tip of the columella with its branches, × 50.

Comatricha longa Peck, p. 175.

Fig. 2. A single empty sporangium, × 6.
Fig. 2 *a*. A part of the same taken near the apex, × 60.
Fig. 2 *b*. A spore, × 1400.

Comatricha aequalis Peck, p. 180.

Fig. 3. A single sporangium, × 10.
Fig. 3 *a*. The columella and capillitium, × 60.
Fig. 3 *b*. A single spore, × 1600.
Figs. 3 *c* and 3 *d*. Sporangia to which the peridium still adheres, although in 3 *c* in shreds.

Stemonitis fusca Rost., p. 160.

Fig. 4. A group of sporangia, × 3.
Fig. 4 *a*. A part of the columella and capillitium, × 60.
Fig. 4 *b*. A single spore, × 1400.

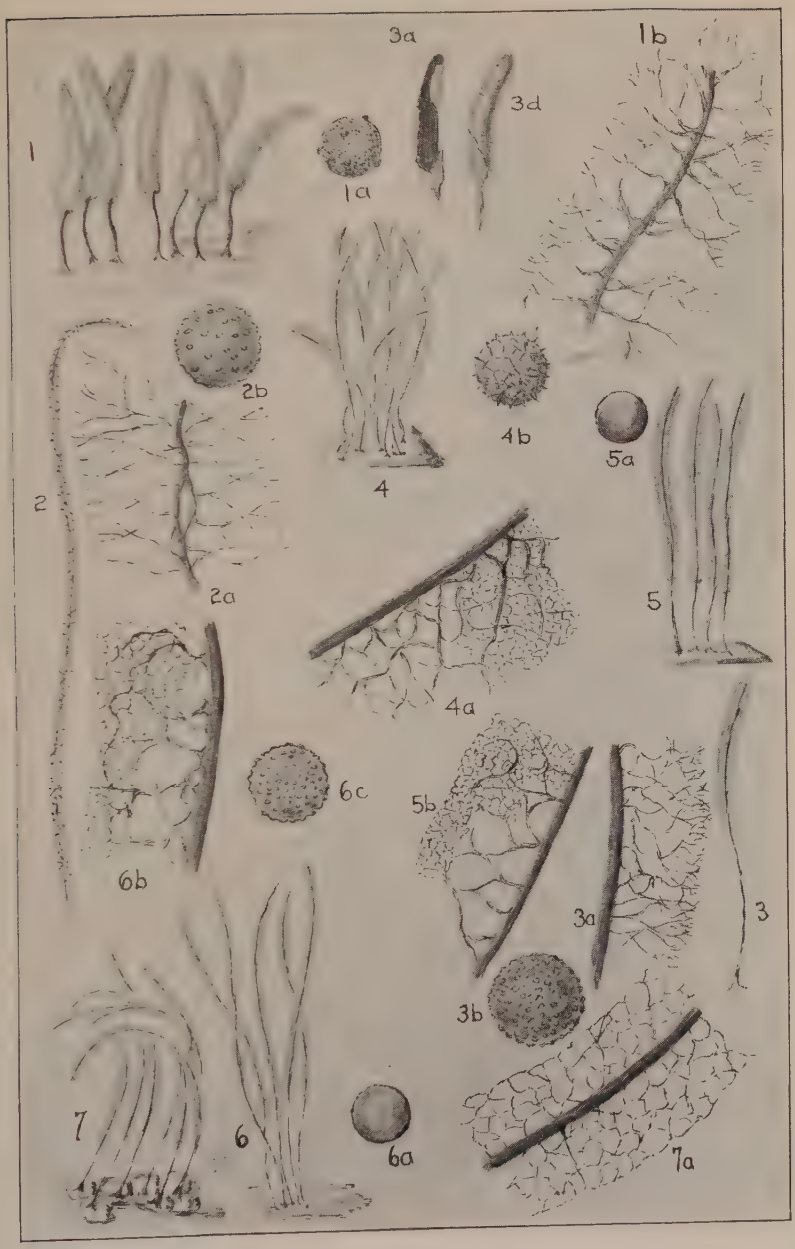
Stemonitis axifera (Bull.) Macbr., p. 168.

Fig. 5. A group of sporangia, × 3.
Fig. 5 *a*. A single spore, × 1400.
Fig. 5 *b*. A part of the capillitium with columella, × 60.

Stemonitis splendens, p. 164.

Fig. 6. A group of sporangia, × 3.
Figs. 6 *a* and 6 *c*. Single spores, the latter × 1400.
Fig. 6 *b*. A part of the columella and branches, × 60.
Fig. 7. A shorter variety of the same species with coarser meshes in capillitium, × 3.
Fig. 7 *a*. A part of the columella and net, × 60.

PLATE VI



EXPLANATION OF PLATE VII

Diachaea splendens Peck, p. 187.

Fig. 1. Sporangia and hypothallus, × 25.
Fig. 1 *a*. Capillitium, × 50.
Fig. 1 *b*. Spores, × 900.
Fig. 1 *c*. Portion of the capillitium, × 150.

Didymium nigripes Fr., p. 123.

Fig. 2. Sporangia, × 30.
Fig. 2 *a*. A spore, × 1400.
Fig. 2 *b*. Calcareous crystals from the peridial wall, × 750.

Didymium melanospermum (Pers.) Macbr., p. 121.

Fig. 3. Sporangia, × 10.
Fig. 3 *a*. A single spore, × about 1000.

Diderma testaceum (Schrad.) Pers., p. 137.

Fig. 4. Sporangia; the first exhibiting the two peridial walls and the spore-mass, × 10.
Fig. 4 *a*. Spore, × 750.
Fig. 4 *b*. Capillitial threads, × 750.

Diderma globosum Pers., p. 134.

Fig. 5. Sporangia; the first with the outer peridium broken away, × 10.
Fig. 5 *a*. A single spore, × 750.

Mucilago spongiosa (Leyss.) Morg., p. 114.

Fig. 6. An æthalium, borne on a grass-stem, natural size.
Fig. 6 *a*. A spore, × 750.
Fig. 6 *b*. Capillitium, with surface calcareous crystals, × 750.

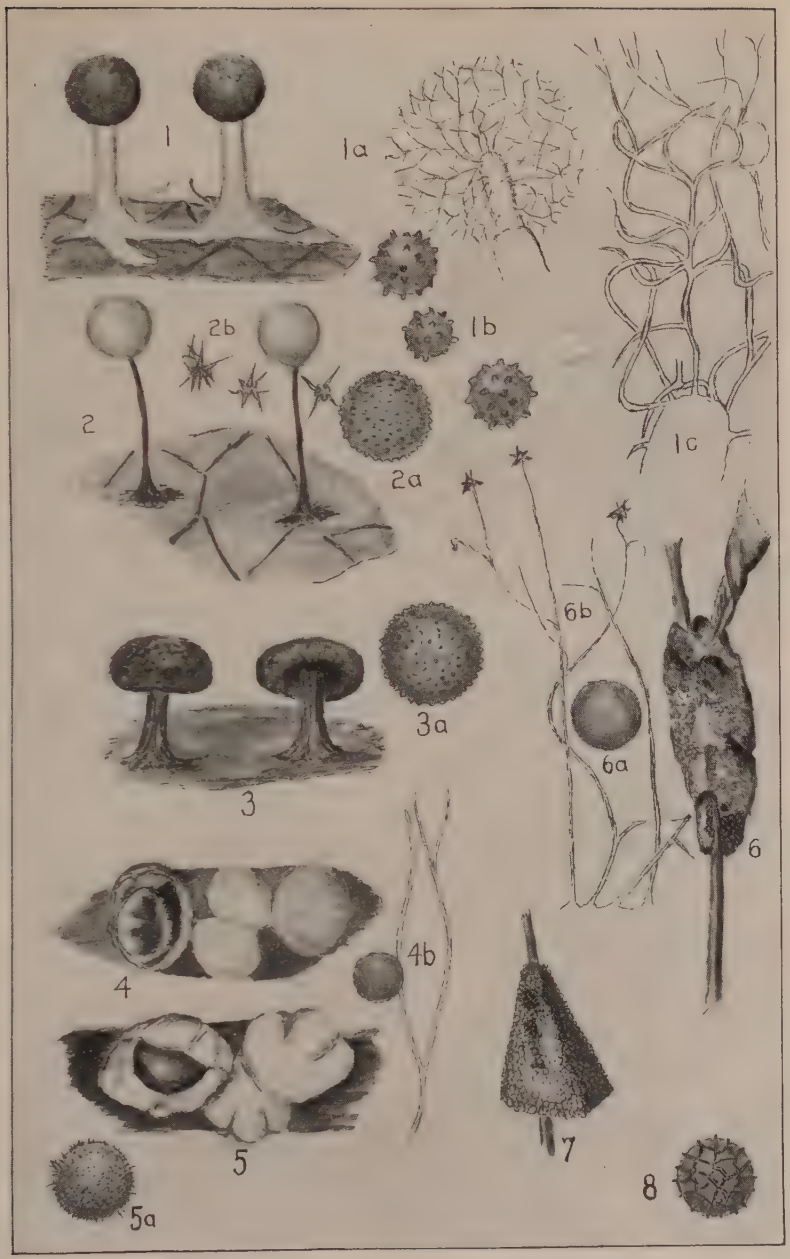
Diderma crustaceum Peck, p. 135.

Fig. 7. A mass of clustered sporangia, to show habit of aggregation, natural size.

Tubifera ferruginosa (Batsch) Macbr., p. 206.

Fig. 8. A single spore, × 1400.

PLATE VII



EXPLANATION OF PLATE VIII

Diderma floriforme (Bull.) Pers., p. 143.

Fig. 1. Sporangia of various ages, × 15.
Fig. 1 *a*. Spore of the same species, × 1000.
Fig. 1 *b*. A capillitial thread, × 1000.

Physarum polycephalum Schw., p. 95.

Fig. 2. The sporangia, × 10.
Fig. 2 *a*. Spores, × 750.
Fig. 2 *b*. Capillitium, × 750.

Leocarpus fragilis (Dicks.) Rost., p. 112.

Fig. 3. Sporangia, × 6.
Fig. 3 *a*. A group of sporangia, natural size, to show habit.
Fig. 3 *b*. A single spore, × 1800.

Physarella oblonga (Berk. & C.) Morg., p. 109.

Fig. 4. A single sporangium, × 8.
Figs. 4 *a* and 4 *b*. Capillitium and spore respectively, × 900.

Craterium leucocephalum (Pers.) Ditmar, p. 105.

Fig. 5. Sporangia, the first closed, × 10.

Physarum sinuosum (Bull.) Weinm., p. 52.

Fig. 6. Plasmodiocarp, natural size; 6 *a*, × 4; see also Plate XIX., Fig. 15.

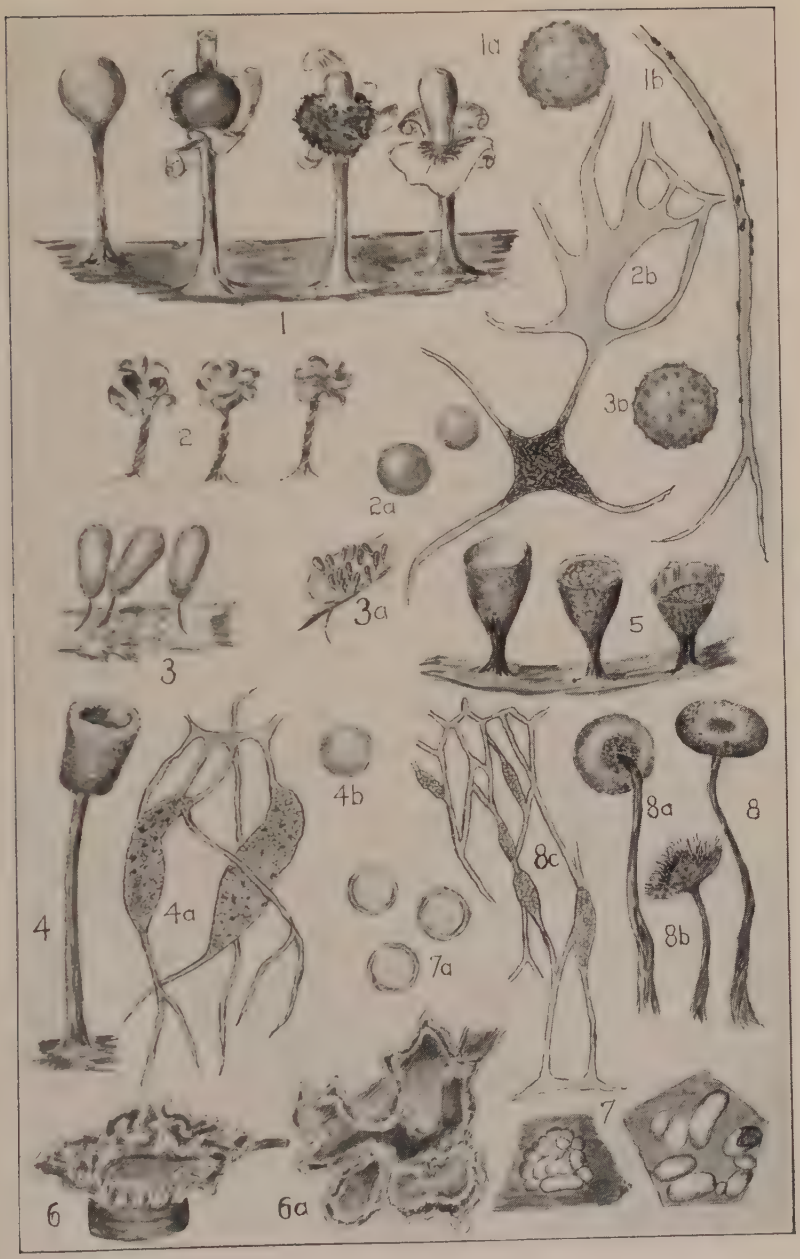
Physarum virescens Ditmar, p. 61.

Fig. 7. Groups of sporangia, × 3 and × 8.
Fig. 7 *a*. Spores, × 750.

Physarum viride Pers., p. 98.

Fig. 8. A single sporangium, × 25; 8 *a*, reverse.
Fig. 8 *b*. The same after spore-dispersal.
Fig. 8 *c*. Capillitium, × 750.

PLATE VIII



EXPLANATION OF PLATE IX

Physarum didermoides (Ach.) Rost., p. 78.

Fig. 1. Sporangia, × 15.
Fig. 1 *a*. A single sporangium open; shows calcareous capillitium, × 15.
Fig. 1 *b*. Spores, × 900.

Physarum notabile Macbr., p. 80.

Fig. 2. A cluster of sporangia, × 15.
Fig. 2 *a*. A single sporangium open, × 15.
Fig. 2 *b*. Spores, × 900.
See also Plate XV., Figs. 2, 2 *a*, and the frontispiece.

Physarum contextum Pers., p. 56.

Fig. 3. A group of sporangia, × 15.
Fig. 3 *a*. Spores of the same, × 600.

Physarum cinereum (Batsch) Pers., p. 59.

Fig. 4. A group of sporangia, × 4.
Fig. 4 *a*. A single sporangium, × 20.
Fig. 4 *b*. Capillitium of the same, × 240.
Fig. 4 *c*. Spores, × 450.

Physarum albescens Ellis, p. 86.

Fig. 5. Sporangia, × 5.
See also Plate XVI., Figs. 4 and 4 *a*.
Fig. 5 *a*. Spore of the same species, × 450.
Fig. 5 *b*. Capillitium of the same, × 240.

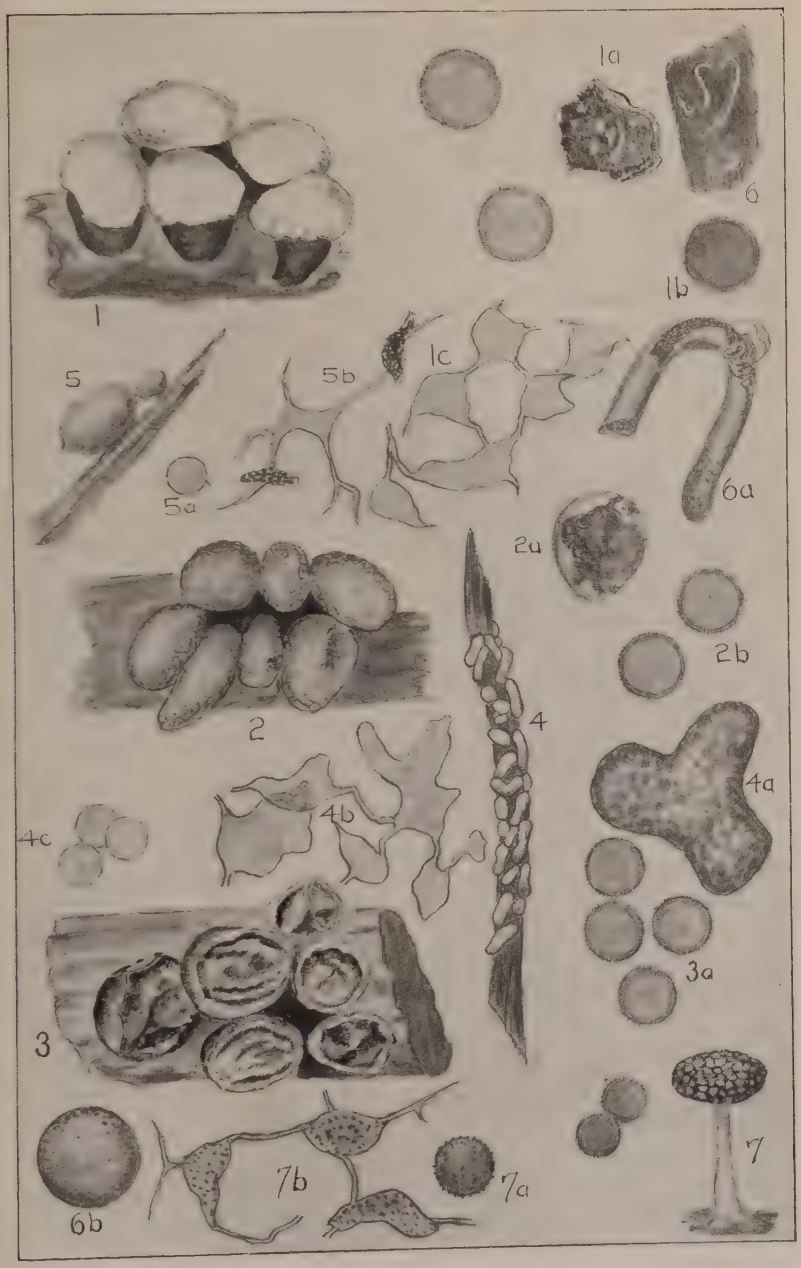
Physarum serpula Morg., p. 49.

Fig. 6. Plasmodiocarps, about natural size.
Fig. 6 *a*. A bit of the plasmodiocarp, showing structure, × 6.
Fig. 6 *b*. A spore of the same species, × 1400.

Physarum leucopus Link., p. 79.

Fig. 7. A single sporangium, × 15.
Fig. 7 *a*. A spore of the same species, × 900.
Fig. 7 *b*. A fragment of the capillitium.

PLATE IX



EXPLANATION OF PLATE X

Badhamia rubiginosa (Chev.) Rost., p. 43.

Fig. 1. A group of sporangia, × 5.
Fig. 1 *a*. Two sporangia, same species, × 18, to show persisting capillitium.
Fig. 1 *b*. Capillitium fragment, × 240.
Fig. 1 *c*. Spore of the same species, × 750.

Fuligo septica (L.) Gmel.; form *laevis*, p. 29.

Fig. 2. An æthalium, natural size.
Fig. 2 *a*. A section of the same, × 10.
Fig. 2 *b*. A spore of the same, × 750.

Fuligo cinerea Pers., p. 26.

Fig. 3. A small æthalium borne upon a blade of grass, natural size. See also Plate XXIII.
Fig. 3 *a*. Capillitial fragment from the same specimen, × 450.
Fig. 3 *b*. Spores of the same, × about 750.

Didymium minus List., p. 121.

Fig. 4. A single sporangium, × 25.
Fig. 4 *a*. The capillitium and fragment of the peridium of the same species, × 380.
Fig. 4 *b*. A spore of the same species, × 1000.

Trichia iowensis Macbr., p. 269.

Fig. 5. Tip of an elater, × 1400.
See also Plate III, 3, 3 *a*, 3 *b*.

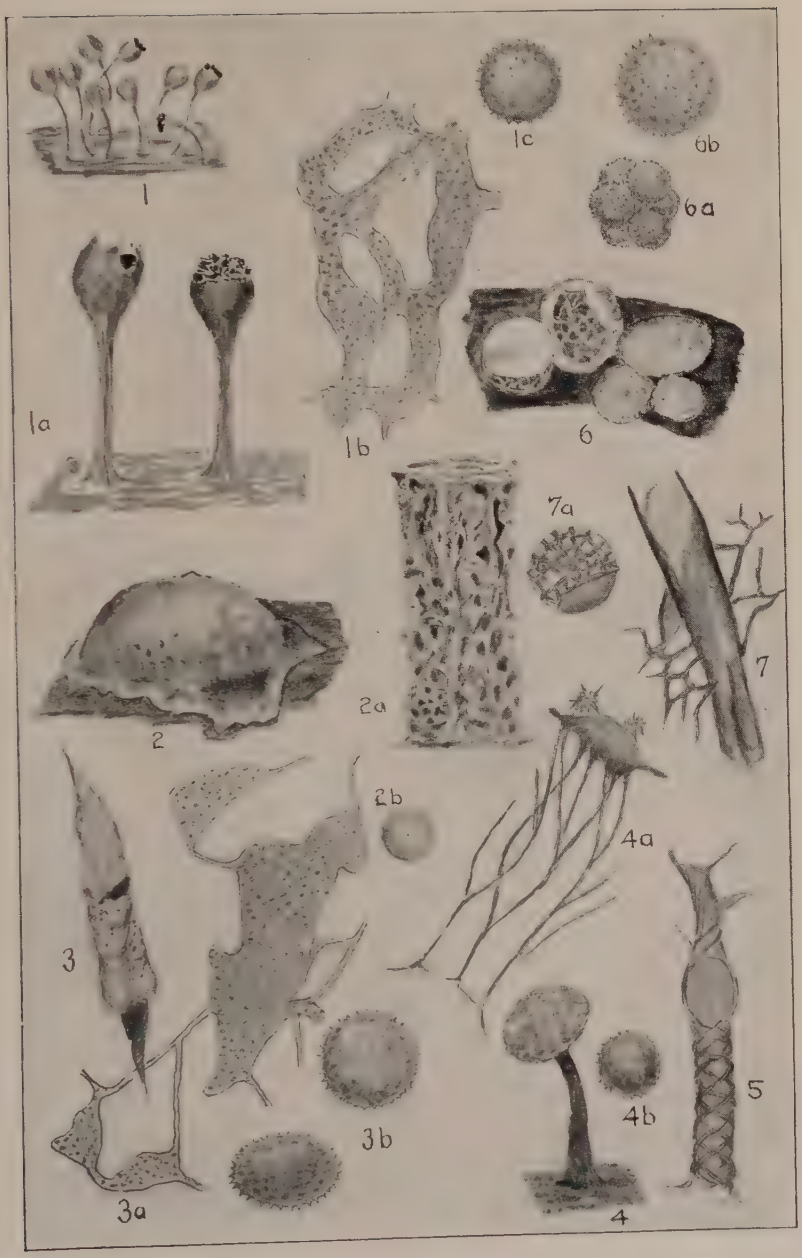
Badhamia papaveracea Berk. & Rav., p. 42.

Fig. 6. Sporangia, a cluster, × 8.
Fig. 6 *a*. A cluster of spores, × 400.
Fig. 6 *b*. A single spore of the same, × 1400.

Reticularia lycoperdon Bull., p. 210.

Fig. 7. A fragment of the capillitium, × 240.
Fig. 7 *a*. A single spore of the same species, × 1400.
See also Plate XII., Fig. 3.

PLATE X



EXPLANATION OF PLATE XI

Comatricha nigra Pers., p. 178.

Fig. 1. A group of sporangia, × 10.
Fig. 2. A single sporangium as in section, × 60.
Fig. 3. A single spore, × 1600.

Stemonitis confluens Ell. & Cke., p. 158.

Fig. 4. A group of sporangia, × 10.
Fig. 4 *a*. A thread of capillitium with adhering disk, × 30.
Fig. 5. A spore of the same, × 2000.

Stemonitis webberi Rex, p. 163.

Fig. 6. A group of sporangia, × 4.
Fig. 7. A single sporangium as in section, × 40.
Fig. 8. A single spore, same species, × 1250.

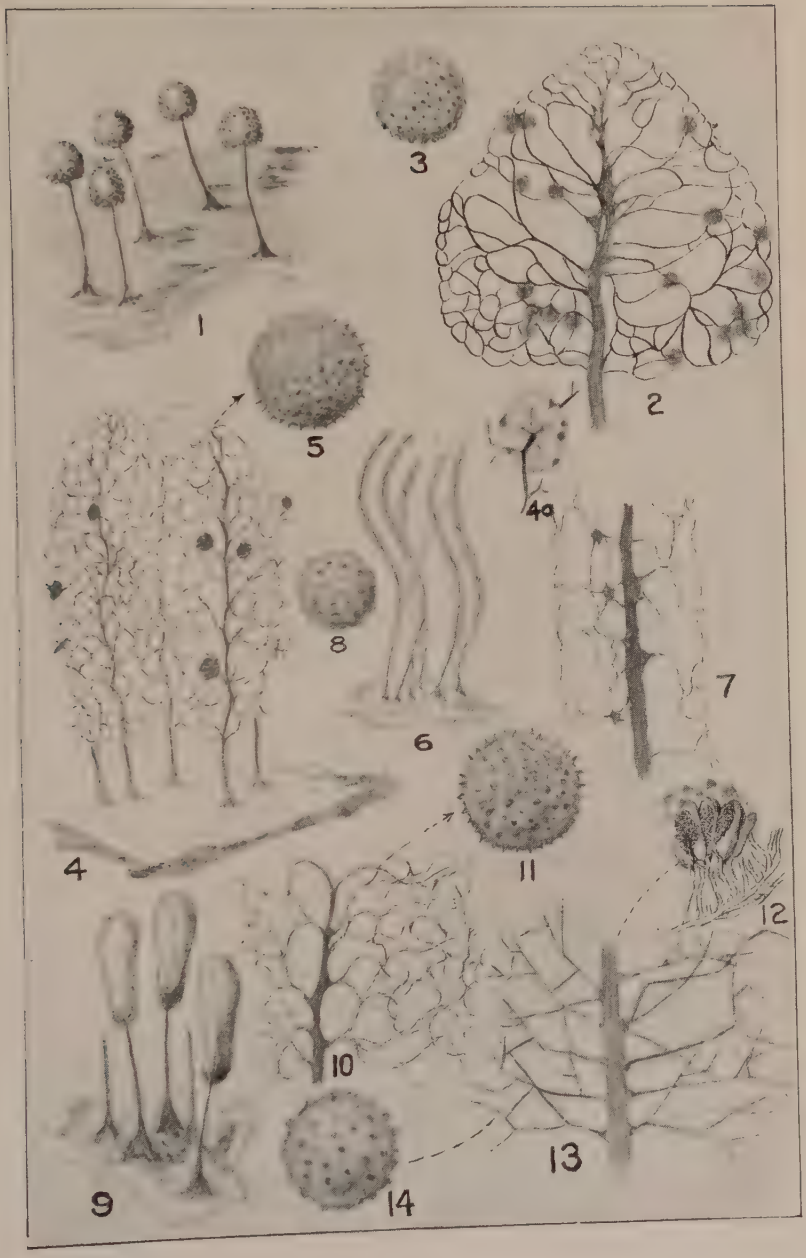
Comatricha suksdorfii Ell. & Ev., p. 178.

Fig. 9. A group of sporangia, × 4.
Fig. 10. A bit of the capillitium, × 60.
Fig. 11. A single spore, × 1600.

Comatricha cæspitosa Sturg., p. 172.

Fig. 12. A cluster of sporangia, × 4.
Fig. 13. The capillitium highly magnified.
Fig. 14. A single spore, × 1600.

PLATE XI



EXPLANATION OF PLATE XII

Lindbladia effusa (Ehr.) Rost., p. 204.

Fig. 1. Fructification, natural size.
Fig. 2. Portion of same in section, × 3.

Reticularia lycoperdon Bull., p. 210.

Fig. 3. Residual capillitial structure, the spores blown away; about natural size.

Enteridium splendens Morg., p. 211.

Fig. 4. Fructification, a large one, natural size.
Fig. 5. Same in section, × 3.

Arcyria ferruginea Sauter, p. 253.

Fig. 6. Three sporangia, magnified about 10 times.
Fig. 6 *a*. A single spore, magnified.
Fig. 6 *b*. Capillitial thread.

Licea variabilis Schrad., p. 200.

Fig. 7. Sporangia, magnified about 6 times.
Fig. 8. Spore, magnified to show surface characters.

Tubifera casparyi (Rost.) Macbr., p. 207.

Fig. 9. A group of sporangia; shows the pseudo-columellæ; × about 5.

Licea biforis Morg., p. 201.

Fig. 10. Sporangia dehiscent, magnified about 10 times.

Orcadella operculata Wing., p. 203.

Fig. 11. Sporangia, magnified about 30 times.

Cribraria argillacea Pers., p. 218.

Fig. 12. Sporangia, magnified about 10 times.
Fig. 13. A single sporangium, × about 40.
See also Plate XVII., Fig. 1.

Tubifera ferruginosa (Batsch) Macbr., p. 206.

Fig. 14. Sporangia magnified to show apiculate tops. Cf.

Comatricha ellisii Morg., p. 184.

Fig. 15. Sporangium, × 40.
Fig. 15 *a*. A single spore, × 1000.

Comatricha pulchella (Bab.) Rost., p. 183; vid. p. 284.

Fig. 16. Sporangium, × 20.
Fig. 16 *a*. A single spore, × 1000.

Comatricha subcaespitosa Peck, p. 282.

Fig. 17. Sporangium, × 20.
Fig. 17 *a*. A single spore, × 1000.

Comatricha gracilis Wingate, p. 184.

Fig. 18. Sporangium, × 20.
Fig. 18 *a*. A single spore, × 1000.

PLATE XII

EXPLANATION OF PLATE XIII

Heterotrichia gabriellæ Mass., p. 257.

Fig. 1. A group of sporangia, one expanded, the others empty, × 15.
Fig. 1 *a*. Capillitium of the species, × 600.

Calonema aureum Morg., p. 266.

Fig. 2. A cluster of sporangia, magnified about 15 times.
Fig. 2 *a*. The tip of an elater of the same species, × 1000.
Fig. 2 *b*. A single spore, × 1000.
Fig. 2 *c*. A bit of the sporangium wall, × 600.

Stemonitis pallida Wing., p. 169.

Fig. 3. Sporangia, magnified about 5 times.

Comatricha pulchella (Bab.) Rost., form *C. persoonii* R., p. 183

Fig. 4. Sporangia, magnified about 15 times.
See Addenda, d, p 283.

Stemonitis carolinensis Macbr., p. 170.

Fig. 5. Sporangia, magnified about 5 times.

Clastoderma debaryanum Blytt., p. 191.

Fig. 6. Sporangium, magnified about 60 times.

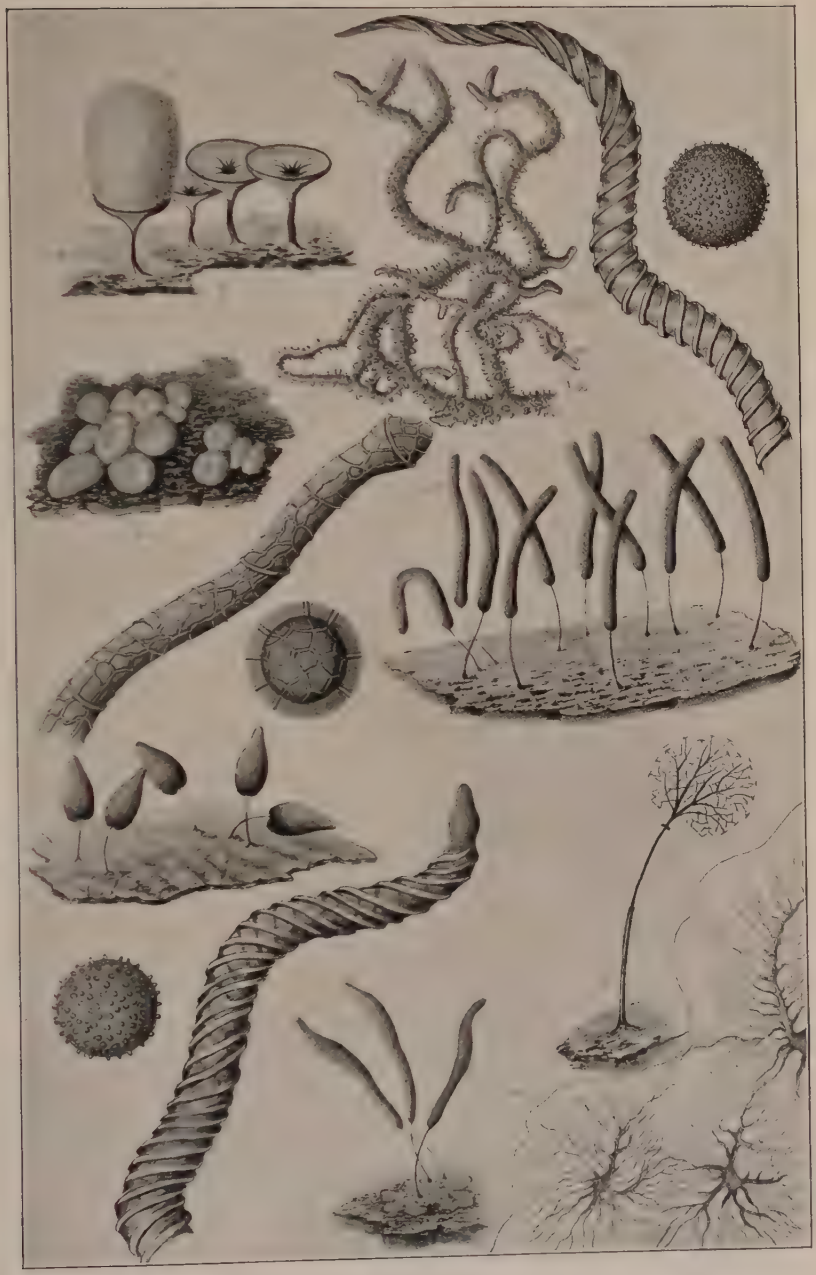
Trichia contorta Rost., p. 269.

Fig. 7. Tip of an elater, × 1400.
Fig. 7 *a*. Spore of the same species, × 1400.

Trichia botrytis Pers., p. 274.

Fig. 8. Tip of the elater, × 1400.
Fig. 8 *a*. Spore of the same species, × 1400.

PLATE XIII



EXPLANATION OF PLATE XIV

Badhamia magna Peck., p. 38.

Fig. 1. A cluster of sporangia, × 10.

Cienkowskia reticulata (Alb. & Schw.) Rost., p. 111.

Fig. 2. Plasmodiocarp, × 15.
Fig. 2 *a*. A bit of the capillitium of the same, × 800.
Fig. 2 *b*. A single spore, × 1000.

Physarum oblatum Macbr., p. 91.

Fig. 3. Sporangia, × 15.
Fig. 3 *a*. A piece of capillitium, × 800.
Fig. 3 *b*. A single spore, × 1000. The roughness much exaggerated.

Badhamia orbiculata Rex, p. 66.

Fig. 4. A group of sporangia, × 10.

Physarum newtoni Macbr., p. 73.

Fig. 5. A group of sporangia, × 16.
Fig. 5 *a*. A single spore, × 1000.
Fig. 5 *b*. A bit of the capillitium, × 800.

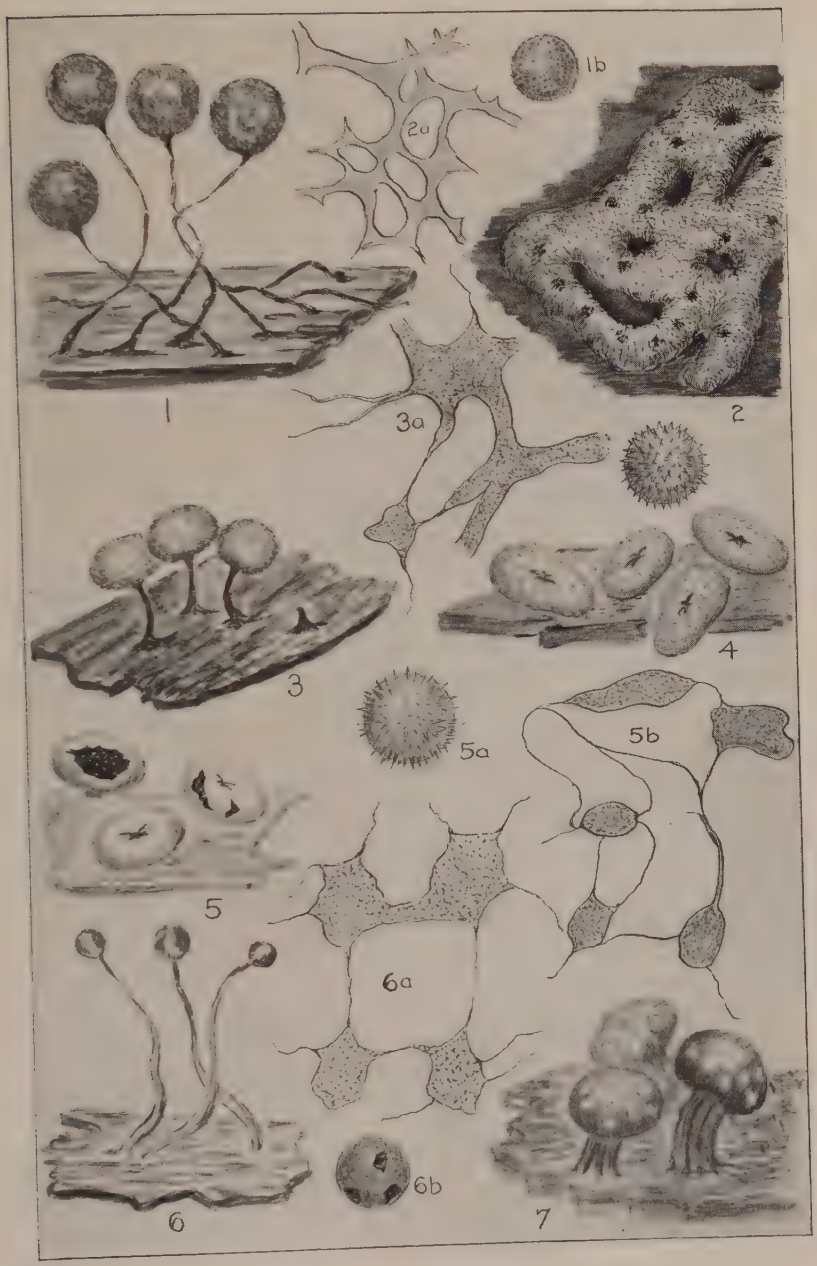
Physarum maculatum Macbr., p. 77.

Fig. 6. A cluster of sporangia, × 10.
Fig. 6 *a*. A piece of the capillitial net, × 800.
Fig. 6 *b*. A single spore, × 800.

Lepidoderma tigrinum (Schrad.) Rost., p. 145.

Fig. 7. A group of sporangia, × 20.

PLATE XIV



EXPLANATION OF PLATE XV

Physarum confertum Macbr. *n. n.*, p. 64.

Fig. 1. Sporangia on a bit of leaf, × 4.
Fig. 1 *a*. Capillitium, × 800.
Fig. 1 *b*. A single spore, × 1200.

Physarum notabile Macbr., p. 80.

Fig. 2. A group of sporangia, stipitate form, × 10.
Fig. 2 *a*. A single spore, × 1200.

Physarum flavicomum Berk., p. 93.

Fig. 3. A cluster of sporangia, one closed, × 10.
Fig. 3 *a*. A single spore, × 1200.

Physarum tropicale Macbr., p. 82.

Fig. 4. Sporangia, × 10.
Fig. 4 *a*. Capillitium, × 800.
Fig. 4 *b*. A single spore, × 1200.

Craterium minutum (Leers) Fr., p. 107.

Fig. 5. Sporangia, the stalks unusually long, × 15.

Physarum penetrale Rex, p. 70

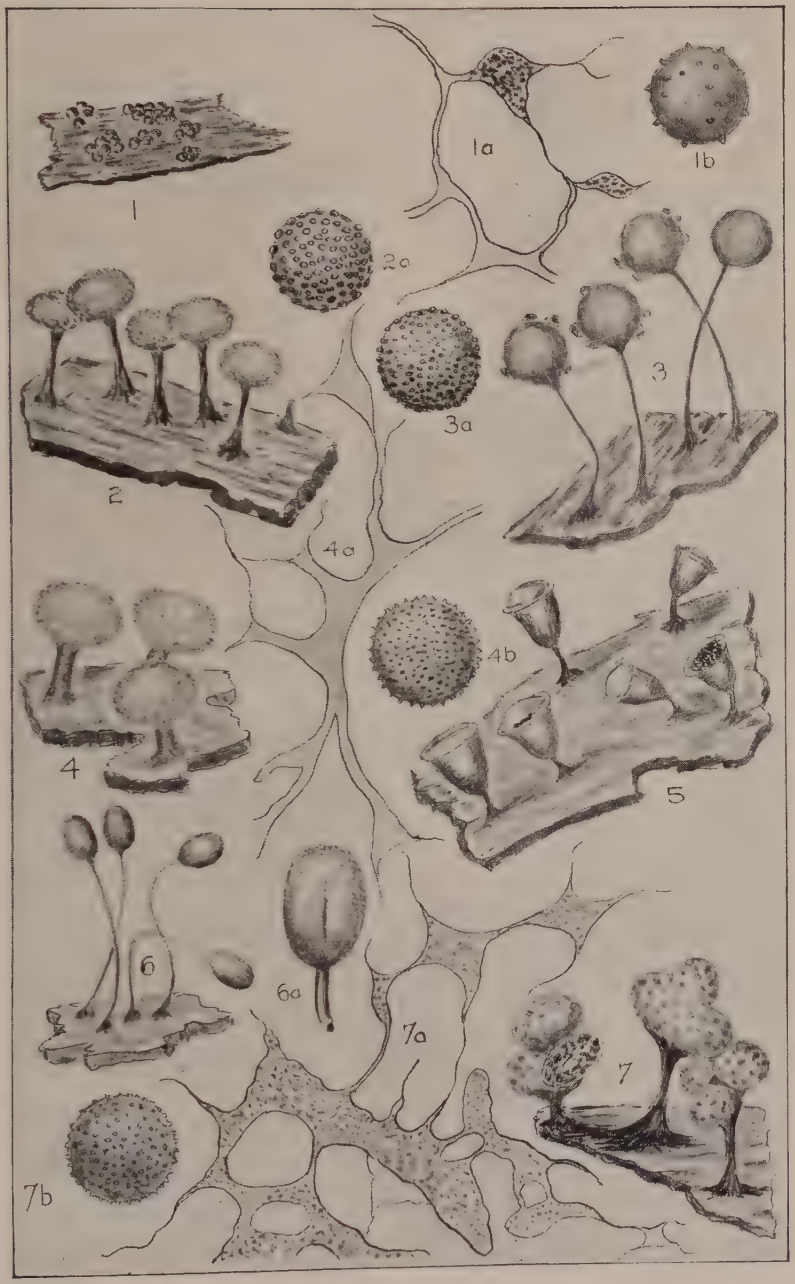
Fig. 6. A group of sporangia; the calcareous crust has fallen in all.
Fig. 6 *a*. A single sporangia, enlarged to show columella, × 20.

Physarum nicaraguense Macbr., p. 83.

Fig. 7. A group of sporangia, × 15.
Fig. 7 *a*. Capillitium, strongly calcareous, × 800.
Fig. 7 *b*. A single spore, × 1200.

See also Pl. XVII., Figs 11 and 11 *a*.

PLATE XV



EXPLANATION OF PLATE XVI

Physarella oblonga (Berk. & C.) Morgan, p. 109.

Fig. 1. Fully opened sporangium, × 10.
Fig. 1 *a*. Tubular sporangia closed, × 5.
Fig. 1 *b*. Transverse section of sporangium; shows trabecular calcareous nodules of the capillitium, × 15.

Craterium cylindricum Mass., p. 106.

Fig. 2. Group of sporangia, × 10.

Physarum wingatense Macbr., p. 72.

Fig. 3. Group of sporangia, × 10.

Physarum albescens Ellis, p. 86.

Fig. 4. Group of sporangia, × 10.
Fig. 4 *a*. Capillitium of the same species, × 200.

Dianema harveyi Rex, p. 238.

Fig. 5. Group of sporangia, × 10.
Fig. 5 *a*. Clustered spores, *D. corticatum*, × 500.
Fig. 5 *b*. Capillitial threads and spores, *D. harveyi*, × 200.
Fig. 5 c. Twisted, spirally striate single threads, × 500; *D. corticatum*, List.

Physarella oblonga Berk. & C., p. 109.

Fig. 6. Terrestial, plasmodiocarpous phase, × 10.

Physarum megalosporum Sturg., p. 63.

Fig. 7. Group of sporangia, × 8.
Fig. 7 *a*. Capillitium and spores, × 150.

Didymium complanatum (Batsch) Rost., p. 116.

Fig. 8. Capillitial structure, × 200.

Physarum wingatense, p. 72.

Fig. 9. Sporangium, × 20, enlarged to show dehiscence.

Didymium xanthopus (Ditm.) Fr., p. 123.

Fig. 10. Sporangium — diagram to show columella, × 20.

Didymium eximium Pk., p. 124.

Fig. 11. Group of sporangia, × 10.
Fig. 11 *a*. Section of sporangium, × 30; diagram.
Fig. 11 *b*. Spore, × 750.

Comatricha elegans (Racib.) List., p. 182.

Fig. 12. A single sporangium, × 20.

Clastoderma debaryanum, p. 191.

Fig. 13. Sporangium, seen in section, × 20.

Stemonitis herbatica Pk., p. 171.

Fig. 14. Group of sporangia, × 2.
Fig. 14 *a*. The same enlarged to show general outline.
Fig. 14 *b*. The same; capillitial section, × 20.
Fig. 14 *c*. A single spore, × 1000.

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EXPLANATION OF PLATE XVII

Cribraria argillacea (Pers.) Schrad., p. 218.

Fig. 1. Sporangium, highly magnified.

Cribraria macrocarpa Schrad., p. 219.

Fig. 2. Sporangium, highly magnified.

Cribraria aurantiaca Schrad., p. 221.

Fig. 3. Sporangium containing spores, × 30.

Cribraria microcarpa Schrad., p. 226.

Fig. 4. Sporangium containing spores, × 30.

Cribraria tenella Schrad., p. 225.

Fig. 5. Sporangium containing spores, × 40.

Cribraria minutissima Schw., p. 220.

Fig. 6. A single sporangium calyculate, × 50.

Fig. 6 *a*. A smaller sporangium without calyx, with spore-mass.

Cribraria cuprea Morg., p. 229.

Fig. 7. A single sporangium, × 50.

Cribraria violacea Rex, p. 227.

Fig. 8. A single sporangium, × 40.

Cribraria piriformis Schrad., p. 224.

Fig. 9. A single sporangium, × 30.

Perichaena depressa (Libert) Rost., p. 242.

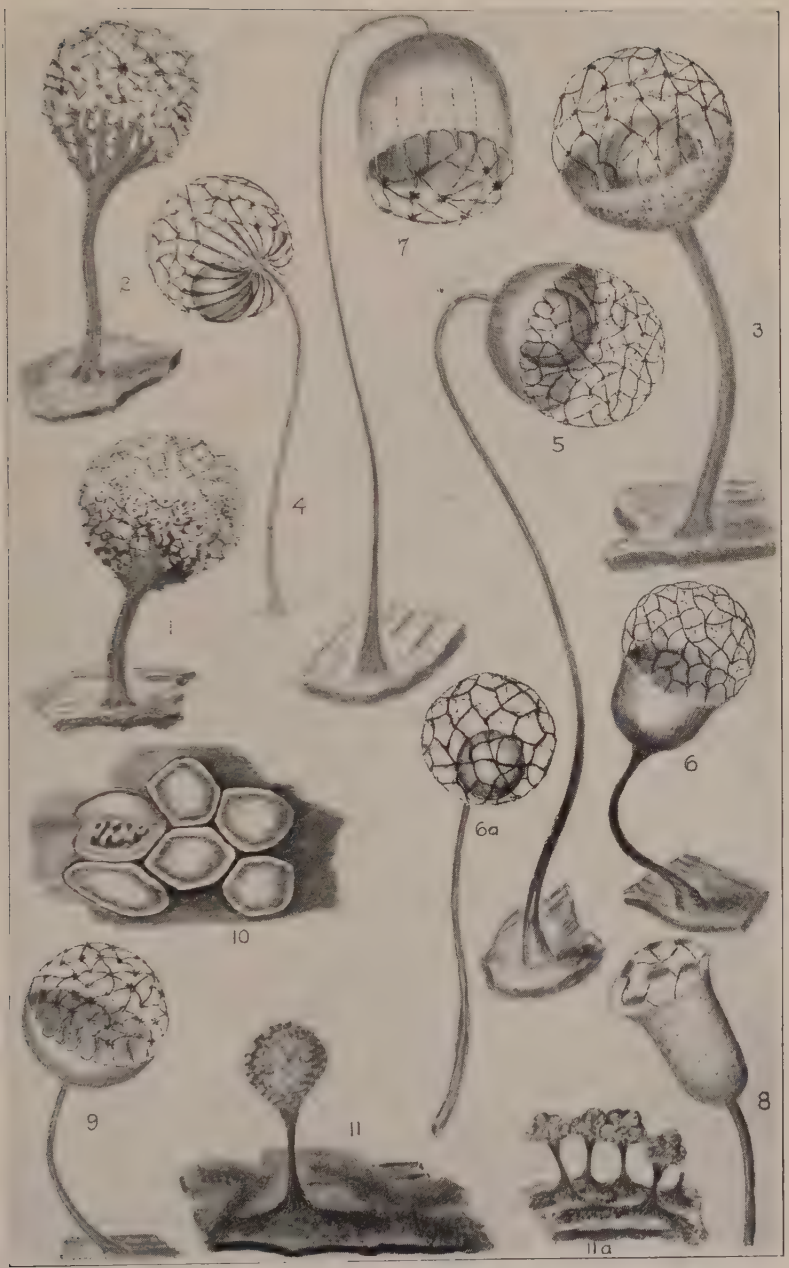
Fig. 10. A cluster of sporangia, one open, × 8.

Physarum nicaraguense Macbr., p. 83.

Fig. 11. Single sporangium, × 10.

Fig. 11 *a*. A cluster of sporangia and hypothallus, × 5.

PLATE XVII



EXPLANATION OF PLATE XVIII

Margarita metallica (Berk. & Br.) List., p. 237.

Fig. 1. A group of sporangia, × 15.
Fig. 1 *a*. Capillitium and spores, × 300.
Fig. 1 *b*. A single spore, × 1200.

Diderma cor-rubrum n. s., p. 140.

Fig. 2. A group of sporangia, × 15.

Diderma asteroides List., p. 143.

Fig. 3. Sporangia-spread, × 6.
Fig. 3 *a*. Same sporangia still unopened, × 4.

Comatricha laxa Rost., Cf. Pl. V., 5 & 5 *a*, p. 184.

Fig. 4. Sporangia, × 10.

Diderma lyallii (Mass.) Macbr., p. 136.

Fig. 5. A group of sporangia, × 10.
Fig. 5 *a*. Capillitium and spores, × 200.

Lepidoderma chailletii Rost., p. 146.

Fig. 6. A group of sporangia, × 15.
Fig. 6 *a*. Capillitium and spores, × 150.
Fig. 6 *b*. A single spore, × 800.

Didymium anellus Morg., p. 117.

Fig. 7. A group of sporangia, × 10.

Diderma radiatum Linn., p. 141.

Fig. 8. A group of sporangia, × 8.

Physarum diderma Rost., p. 55.

Fig. 9. A group of sporangia, × 10.

Diderma rugosum (Rex) Macbr., p. 144.

Fig. 10. A group of sporangia, × 10.

Diderma niveum (Rost.) Macbr., p. 137.

Fig. 11. A group of sporangia, × 10.
Fig. 11 *a*. Spore and capillitium, × 600.

Prototrichia metallica (Berk.) Mass., p. 258.

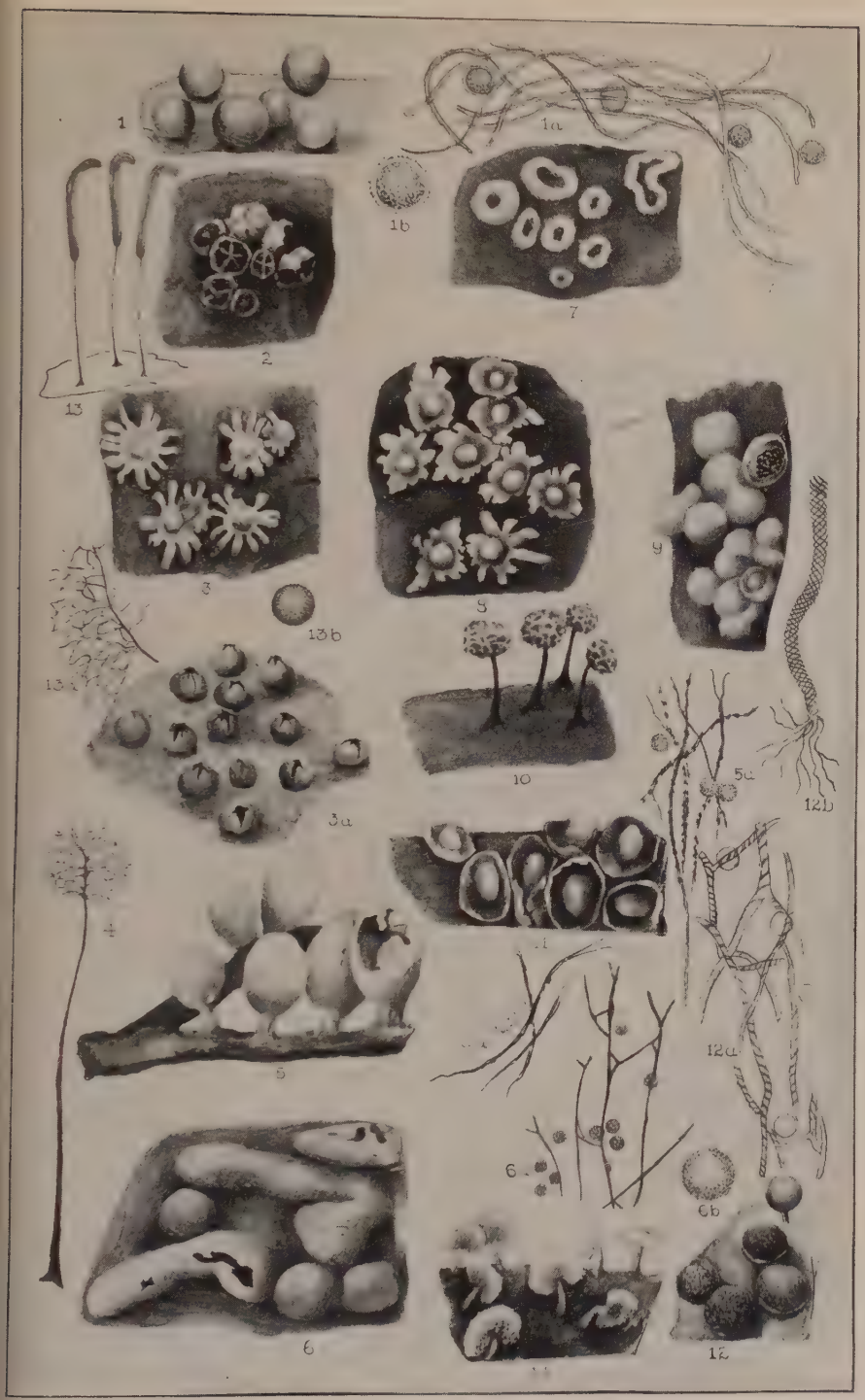
Fig. 12. A group of sporangia, × 10.
Fig. 12 *a*. Same; capillitium and spores, × 300.
Fig. 12 *b*. Tip of a capillitium thread to show spiral markings and end-fraying, × 800.

Comatricha aequalis Peck, p. 180.

Fig. 13. A group of sporangia, × 5.
Fig. 13 *a*. Sporangium tip, capillitium, × 200.
Fig. 13 *b*. Spore, × 800.

Physarum compressum Alb. & Schw., p. 80.

Fig. 14. A group of sporangia to show compressed form, × 10.
See also Plate XIX., Fig. 12.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EXPLANATION OF PLATE XIX

Dictydium cancellatum Batsch, p. 230.

Fig. 1. The finest phase, as the form appears in the Mississippi valley, × 15.

Fig. 1 *a*. Sporangium of the same seen from below, × 35.

Fig. 1 *b*. Sporangium—same—seen from above, × 35.

Fig. 1 *c*. Cribraria-like net from the top, × 200.

Fig. 2. Vertical section of what is believed the typical European form, × 20.

Fig. 3. An ellipsoidal piriform phase — var. *prolatum*, × 15.

Physarum compressum Alb. & Schw. form *P. affine* Rost., p. 80.

Fig. 4. A group of sporangia, × 12.

Fig. 4 *a*. A single spore, × 600.

Fig. 4 *b*. Capillitium, same species, × 300.

Alwisia bombarda Berk. & Br., p. 209.

Fig. 5. Open sporangia, × 6.

Fig. 5 *a*. Sporangium of same enlarged to show capillitium, × 20.

Cribraria dictydiodes Cke. & Balf., p. 222.

Fig. 6. A group of sporangia, × 6.

Fig. 6 *a*. Single sporangium of same — lateral view, × 25.

Fig. 6 *b*. Same; base view, × 30.

Cribraria aurantiaca Schrad., p. 221.

Fig. 7. Single sporangium, × 30.

Cribraria rufa (Roth) Rost., p. 220.

Fig. 8. Sporangium, × 30.

Cribraria piriformis Schrad., p. 224.

Fig. 9. Sporangium, × 30.

Cribraria splendens (Schrad.) Pers., p. 221.

Fig. 10. Sporangium, × 30.

Echinostelium minutum DeBy., p. 198.

Fig. 11. Several sporangia, × 15.

Fig. 11 *a*. Vertical section, after Rost., × 500.

Physarum compressum Schw., p. 80.

Fig. 12. Sporangium, × 20, to show dehiscence.

Didymium anomalum Sturg., p. 127.

Fig. 13. Plasmodiocarps, about natural size.

Fig. 13 *a*. Diagrammatic vertical section, etc., to show the calciferous pillars distinguishing the species, × 200.

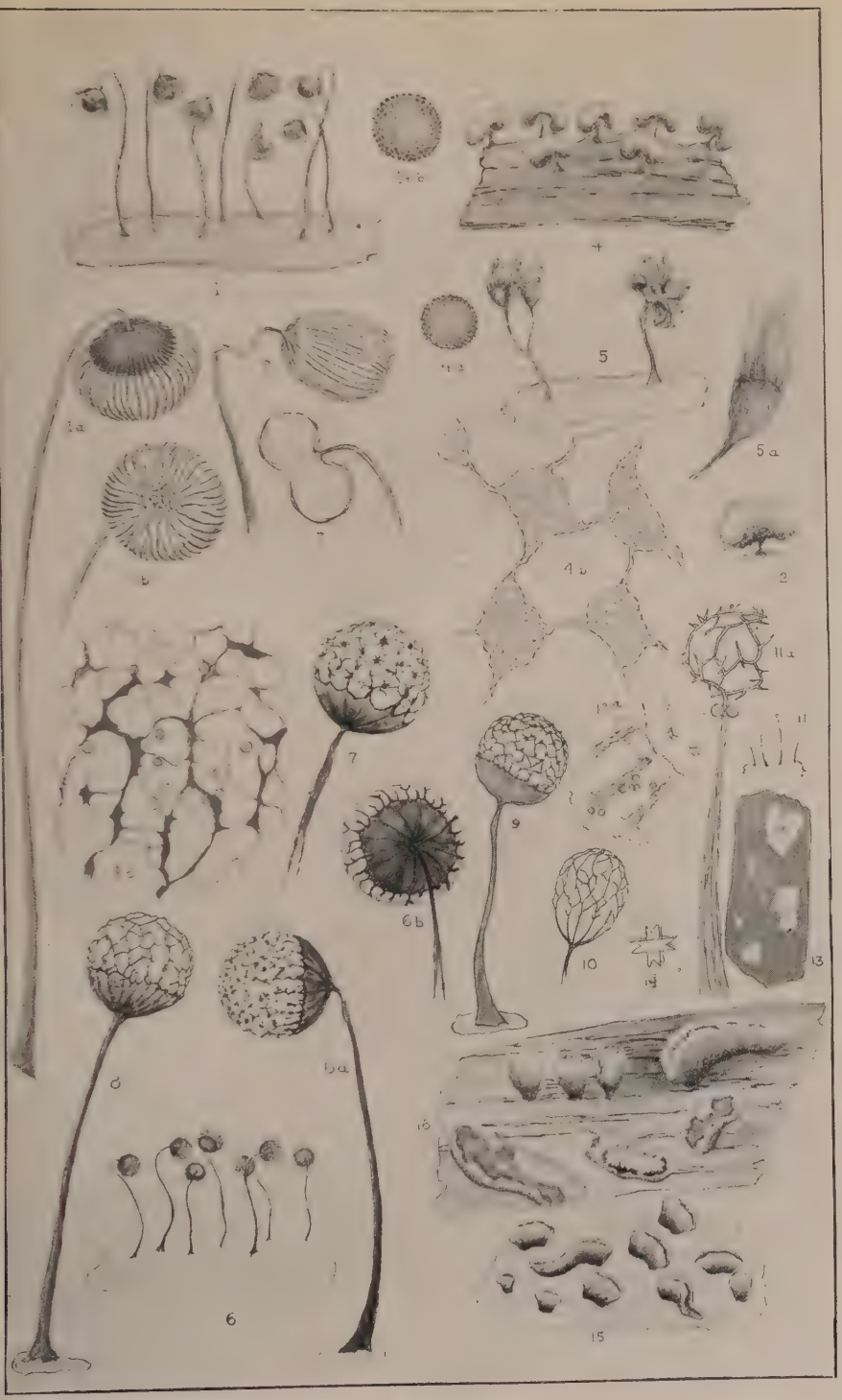
Fig. 14. Calcic crystal — enlarged.

Physarum sinuosum (Bull.) Weinm., p. 52.

Fig. 15. Plasmodiocarps passing to sporangia, × 5.
Cf. Plate VIII., 6 and 6 *a*.

Physarum bitectum List., p. 53.

Fig. 16. Plasmodiocarps as in 15, showing transional phases, × 10.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EXPLANATION OF PLATE XX

Badhamia iowensis n. s., p. 36.

Fig. 1. Sporangia several presentations, × 15.
Fig. 1 *a*. Capillitium, × 200.
Fig. 1 *b*. Single spore, × 500.

Physarum mortoni n. s., p. 58.

Fig. 2. A group of sporangia, × 20.
Fig. 2 *a*. Capillitium, × 200.

Physarum discoidale n. s., p. 74.

Fig. 3. A group of sporangia, × 10.
Fig. 3 *a*. A single spore, × 800.

Didymium annulatum n. s., p. 125.

Fig. 4. Group of sporangia, × 15.
Fig. 4 *a*. Capillitium and spores, × 200.

Oligonema brevifilum Peck, p. 280.

Fig. 5. Capillitium, × 800.
Fig. 5 *a*. The same.
Fig. 12 *b*. A single spore, × 800.

Amaurochaete tubulina (Alb. & Schw.) Macbr., p. 150.

Fig. 6. Capillitium and spores, × 200.
Fig. 6 *a*. Spore, × 1200.

Physarum brunneolum (Phill.) Mass., p. 58.

Fig. 7. Group of sporangia.
Fig. 7 *a*. The same, mature, dehiscence beginning, × 10.
Fig. 7 *b*. A single spore, × 800.

Stemonitis uvifera n. s., p. 161.

Fig. 8. Colony, natural size.
Fig. 8 *a*. Capillitium and spore-clusters, × 30.
Fig. 8 *b*. Single spore-cluster, × 600.
Fig. 8 *c*. Spore, × 1000.

Stemonitis trechispora Berk., p. 160.

Fig. 9. Fructification — natural size.
Fig. 9 *a*. Capillitium, branch and threads, × 20 — the spores enlarged.
Fig. 9 *b*. Netted spore, × 1000. Masking as an amaurochete; *A. trechispora* perhaps; compare 11, etc., below.

Stemonitis flavogenita Jahn, p. 169.

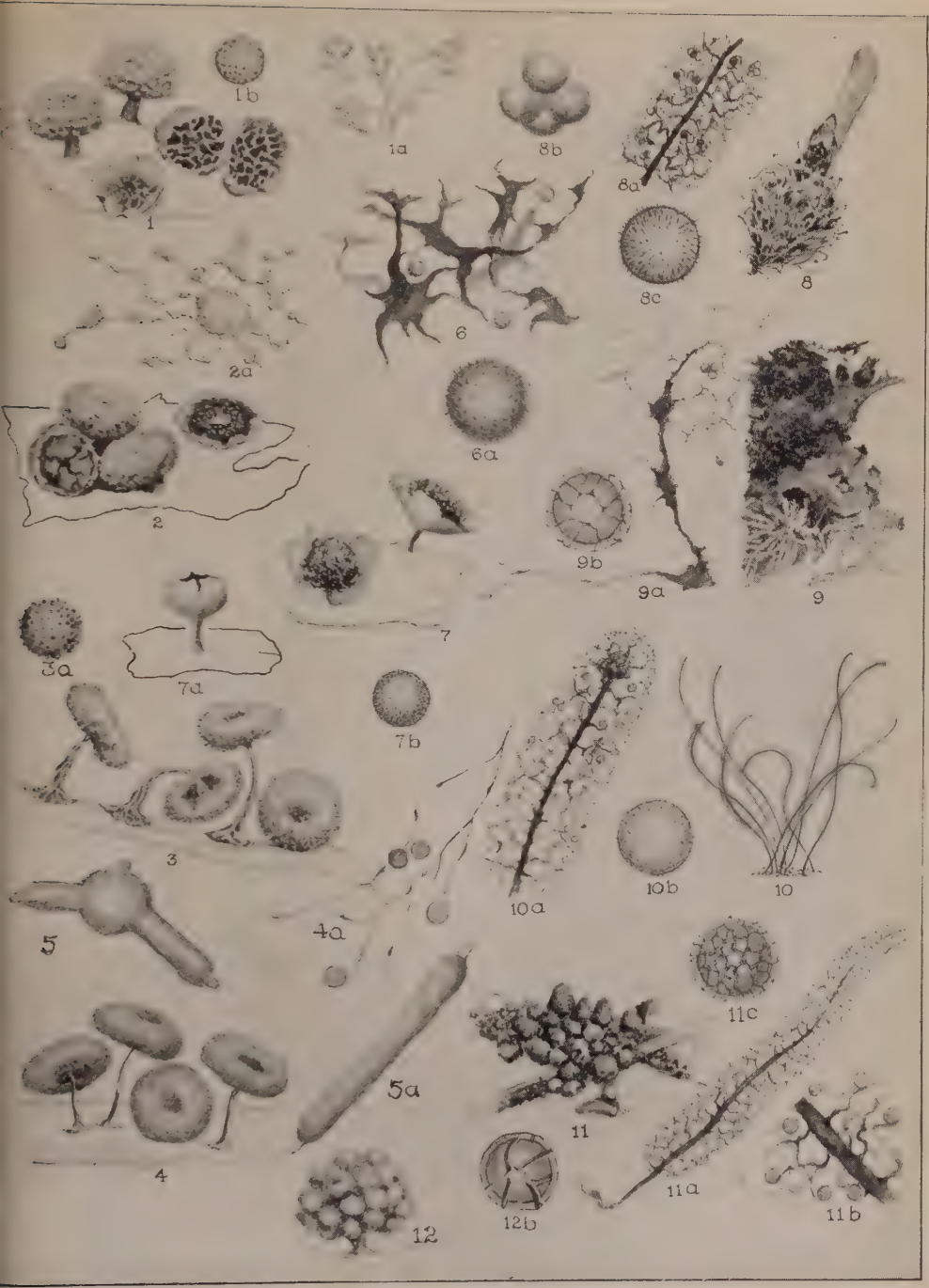
Fig. 10. A group of sporangia, × 3.
Fig. 10 *a*. Capillitium showing columella-tip, × 50.
Fig. 10 *b*. Spore, × 1200.

Stemonitis trechispora (Berk.) Torr., p. 159.

Fig. 11. A group of sporangia, × 3.
Fig. 11 *a*. Diagram of a single sporangium, a less rudimentary specimen, × 40.
Fig. 11 *b*. Capillitium enlarged to show branching columella, × 40.
Fig. 11 *c*. A single spore, × 1200.

Arcyria pomiformis (Leers) Rost., p. 255.

Fig. 12. A globose colony of sporangia, × 10; var. *conglobosa*.
Fig. 12 *b*. See under 5, above.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EXPLANATION OF PLATE XXI

Brefeldia maxima (Fr.) Rost., p. 154.
A typical, beautiful æthalium, about natural size.

PLATE XXI

EXPLANATION OF PLATE XXII

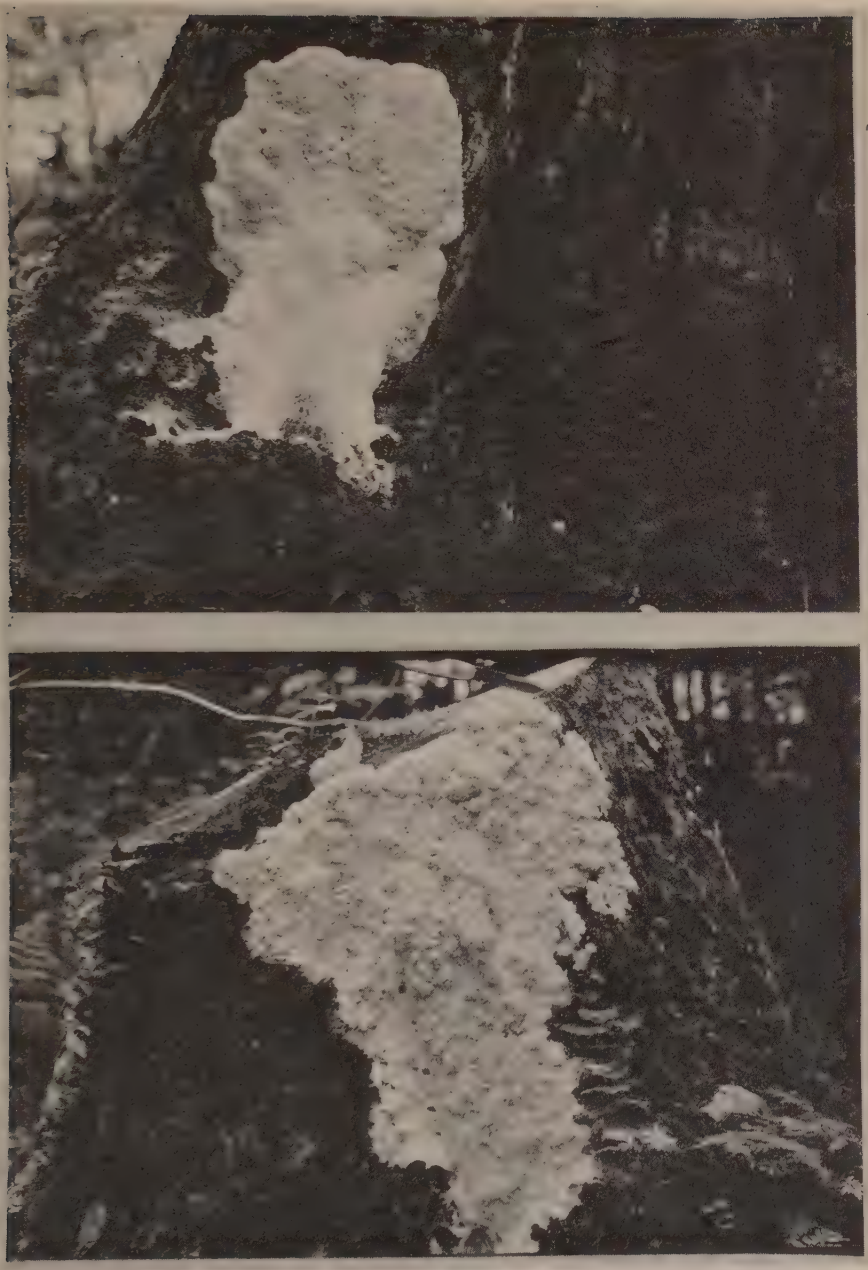
Brefeldia maxima Rost., p. 154.

Fig. 1. Plasmodium active; climbing the stump.

Fig. 2. Same plasmodium urgent; moving at the rate of 2 cm. per minute.

From photo-prints by Mr. W. A. Seaman and Mr. John F. Reeder, Mich. The figures are about one-sixth the natural size of the object. See plate preceding for the mature phase of this species, natural size.

PLATE XXII



EXPLANATION OF PLATE XXIII

Fuligo cinerea (Schw.) Morg., p. 26.

1. The plasmodium; urgent!
2. The perfected fruit; quiescent.

The figures present their objects about natural size. See also Plate X., Figs. 3, 3 *a*, 3 *b*, for further illustration.

From photo-prints by John T. Reeder, Mich.

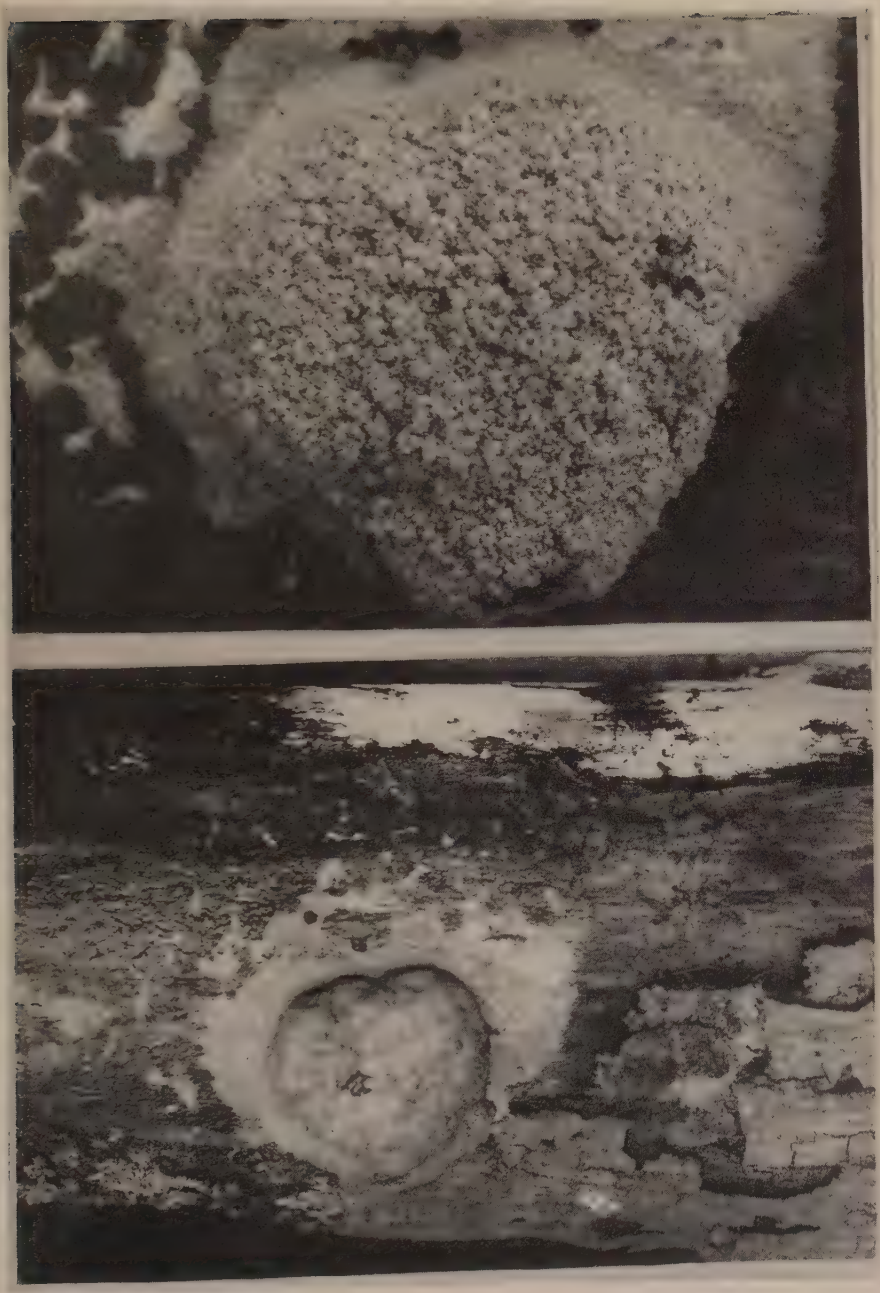



PLATE XXIII